

UDANGUDI STPP STAGE-I (2x660 MW)

TECHNICAL SPECIFICATION NATURAL DRAFT COOLING TOWER (ELECTRICAL PORTION)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP [INDIA]**



TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR NATURAL DRAFT COOLING TOWER UDANGUDI STPP STAGE-I (2x660 MW)	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION: C
	REV NO. : 00 DATE: 09.05.2018
	SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	SPECIFIC TECHNICAL REQUIREMENTS	2
C	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEURE-I)	3
C	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
C	CABLE SCHEDULE FORMAT (ANNEXURE-III)	5
C	TECHNICAL SPECIFICATION FOR MOTORS	9
C	TECHNICAL SPECIFICATION FOR CABLING	104
C	TECHNICAL SPECIFICATION FOR ILLUMINATION	14
D	GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	5
D	MOTOR DATASHEET-A	1
D	MOTOR DATASHEET-C	2
D	REFERENCE QUALITY PLAN	
	MOTOR BELOW 55 KW	2
	MOTOR 55 KW & ABOVE	9
	CABLE TRAY & ACCESSORIES	5
	CABLE TRAY SUPPORT	2
	CABLES	10
	EARTHING & LIGHTING PROTECTION	2
	JUNCTION BOX	6
	ILLUMINATION	5
	MANDATORY SPARES	1

Total Sheet including cover & content sheet = 191

The requirements mentioned in Section-C / Data Sheets-A of section D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-D.



TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
NATURAL DRAFT COOLING TOWER
UDANGUDI STPP STAGE-I (2x660 MW)**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION : **C**

REV NO. : **00** DATE : **09.05.18**

SHEET : 1 OF 2

SECTION-C
(ELECTRICAL PORTION)



TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR NATURAL DRAFT COOLING TOWER UDANGUDI STPP STAGE-I (2x660 MW)	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION : C
	REV NO. : 00 DATE : 09.05.18
	SHEET : 2 OF 2

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Natural draft cooling Tower.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.
- k) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS) REV-0, DATE: 09.05.2018

PACKAGE: COOLING TOWER (NATURAL DRAFT) Annexure-I

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: UDANGUDI STPP STAGE-I (2x660 MW)

SECTION-C

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre Optic cables etc.	Vendor	Vendor	Refer scope/ C&I portion of specification for scope of fibre Optic cables if used between PLC/ microprocessor & DCS.
6	Cabling material (Cable trays, accessories & cable tray supporting system)	Vendor	Vendor	1. Layout details between vendors supplied equipment & installation dwgs by vendor. 2. BHEL will provide cable trench/cable racks/cable pedestals along with cabling material up to the terminal point approx. 10 m away from cooling tower. Further cabling (supply and E&C) shall be in vendor's scope.
7	Cable glands ,lugs, and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Equipment grounding (including electronic earthing) & lightning protection	Vendor	Vendor	Material and sizes shall be as per specification and subject to BHEL approval during detailed engineering stage. Refer note no. 4 for electronic earthing.
9	Below grade grounding	BHEL	Vendor	MS Rod material shall be provided by BHEL. All other materials/ consumables are in vendor's scope.
10	LV Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS) REV-0, DATE: 09.05.2018

PACKAGE: COOLING TOWER (NATURAL DRAFT) Annexure-I

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

SECTION-C

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Lighting System	Vendor	Vendor	In addition to other lighting system items, vendor shall consider aviation lights & their control as per statutory requirement and Lighting panels (LP) & timer control as per requirement. Further wires, any other material required for lighting system shall also be considered by vendor in their scope. BHEL will provide the power supply along with LDB at one location near Cooling Tower for feeding cooling tower vendor LPs/other lighting loads. Further distribution including material is in vendor scope.
12	Aviation Lighting	Vendor	Vendor	
13	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
14	Engineering activities during detailed engineering stage, including those listed below: a. Electrical load data submission in PEM format b. Electrical equipment GA drawings and layout drawings c. Cable trench/ tray layout drawings d. Control & Instrumentation cable schedules showing routing details [including electronic earthing cable & cables supplied by PEM for CT equipment]. e. Grounding and lightning protection system layouts f. Cable termination/ interconnection details (diagram)/ Cable block diagram	Vendor	--	1. Documentation shall be submitted as per project schedule for BHEL/ customer approval. 2. Vendor shall be responsible for necessary coordination with BHEL for required engineering interfacing during contract stage. 3. Any approval required from electrical inspection authority for electrical equipment shall be arranged by vendor.

NOTES:

PACKAGE: COOLING TOWER (NATURAL DRAFT) Annexure-I

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

SECTION-C

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their civil assignment drawing.

[illegible]

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

please refer below examples:

- i) 3C x 120 sq. mm. (1.1kV) PVC FRLS, Unarmoured Aluminium cable, the voltage code shall be D03G120
- ii) 3C x 2.5 sq. mm. (1.1kV) PVC FRLS, Unarmoured Copper cable, the voltage code shall be D03C2.5
- iii) 3.5C x 120 sq. mm. (1.1kV) PVC non-FRLS, Armoured Aluminium cable, the voltage code shall be D3HF120

(A) **SYSTEM VOLTAGE CODES:**

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) **CABLE VOLTAGE CODES:**

A = 11KV (Power cables)
B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) **CABLE CODES**

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

PVC Aluminium

E = Armoured FRLS

G = unarmoured FRLS

F = Armoured Non-FRLS

H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS

L = unarmoured FRLS

K = Armoured Non-FRLS

M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS

Q = unarmoured FRLS

P = Armoured Non-FRLS

R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES

T = TOUGH RUBBER SHEATH

U = OVERALL SCREENED

V = PAIRED OVERALL SCREENED

W = PAIRED INDIVIDUAL SCREENED

Y = COMPENSATING CABLES

I = PRE-FABRICATED CABLES

Z = JELLY FILLED CABLES

6. Once a cable list has been given to PEM for routing, any subsequent changes required in the cable list (which may be in the form of addition of cables, deletion of cables, change of type or size of cable, etc.) must be informed as specific changes (as a separate file MS Excel of the same format as the original file) to the cable list given earlier if the cable list has been routed and cable schedule generated. The routing status of the cable list shall be got confirmed from PEM by the agency that has prepared the cable list before the changes are intimated. In case PEM confirms that the cable list in question has not been taken up for routing, and the revised cable list is acceptable,

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

the same may be sent. Since cable routing through the program involves adding each cable list to the project cable schedule database, the original cable schedule shall not be furnished to PEM with revisions incorporated within.

7. For any assistance or clarifications, please contact <mailto:praveendutta@bhelpem.co.in>



SECTION-3.16: MOTORS

1.0.0 INTENT OF SPECIFICATION

This section covers the technical requirements of HT motors, LT Motors and DC motors.

2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and /or supplemented by this specification.

- | | |
|-----------------|--|
| a) IS: 325 | Three phase induction motors |
| b) IS: 12615 | Energy efficient induction motors |
| c) IS: 900 | Code of practice for installation and maintenance of induction motors |
| d) IS: 996 | Single-phase AC induction motor for general purpose |
| e) IS: 1231 | Dimensions of three-phase foot-mounted induction motors |
| f) IS: 2223 | Dimensions of flange mounted AC induction motors |
| g) IS: 4029 | Guide for testing three-phase induction motors |
| h) IS: 8789 | Values of performance characteristics for three-phase induction motors |
| i) IS: 13555 | Guide for selection and application of 3-phase AC induction motors for different types of driven equipment |
| j) IS: 5571 | Guide for selection of electrical equipment for hazardous areas |
| k) IS: 12065 | Permissible limits of noise level for rotating electrical machines |
| l) IS: 12075 | Mechanical vibration of rotating electrical machines |
| m) IS 60034-5 | Degree of protection provided by Integral design of rotating electrical machines |
| n) IS 60034-8 | Terminal marking and direction of rotation |
| o) IS 60079-1 | Equipment protection by flame proof enclosure |
| p) IS 60034-1 | Rotating electrical machines. |
| q) IS 60079 | Explosive atmospheres |
| r) IS/IEC 60529 | Degrees of protection provided by enclosures (IP code) |
| s) IEC 60034 | Rotating electrical machines. |
| t) IS 3177 | Code of practice for Design, Manufacture, Erection and testing of Cranes and Hoists |

3.0.0 TECHNICAL REQUIREMENTS

3.1.0 Design ambient temperature

Motors shall be suitable for an ambient temperature of 50 degree C and relative humidity of 95% and shall deliver the rated output without exceeding its guaranteed temperature limits.

3.2.0 Supply voltage

Motors rated up to and including 415 V are termed as LT motors and the motors rated higher than 415 V are termed as HT motors.

Motors shall be capable of delivering the rated output under following voltage and frequency variations without exceeding its guaranteed temperature limits.



- Frequency variation : (+) 3% and (-) 5%
- Voltage variation for LT motors : ($\pm$) 10%
- Voltage variation for HT motors : ($\pm$) 6%
- Combined variation of voltage and frequency : 10% (absolute sum)

All the motors shall be so designed that maximum inrush currents, locked rotor torque and pullout torque developed at extreme voltage and frequency variations do not endanger the motor and the driven equipment.

3.3.0 System Parameters

Sl. No.	Description	11 kV and 6.6 kV System	LT System
1.	Voltage level	6.6 kV : Above 200 kW and upto 2000 kW 11 kV: Above 2000 kW	240 V : up to 0.2 kW 415 V: >0.2 kW and up to 200 kW.
2.	System earthing	Earthed through resistance, limiting earth fault current to 300 Amps	415 V system solidly grounded.
3.	Fault withstand rating of motor terminal box (Breaker operated)	50 kA for 0.2 sec for 11 kV and 31.5 kA for 0.2 sec for 6.6 kV	415 V system : 50/65 kA for 0.2 second

3.4.0 Type

AC Motors shall be squirrel cage induction type unless otherwise it is specified.

3.5.0 Duty

- All AC motors shall be squirrel cage three phase/single phase induction motors. All the motor shall be designed for bi-directional rotation.
- All the motors shall be rated for S1 duty for continuous operation. Motors of crane and hoist application shall be intermittent duty.
- DC motor shall generally be of shunt wound type rated for 220 V DC.
- Motors shall be suitable for installation in hot, humid and tropical atmosphere and polluted at places with coal ash and or fly ash.
- The motors shall be suitable for bus transfer schemes provided on the 11 kV/6.6 kV/415 V systems without any injurious effect on its life.

3.6.0 Design margin

Whenever the basis for motor rating are not specified in the corresponding mechanical specification section maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.

The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating; pull up, breakdown and full load torques are available for the intended service.

Service shall be considered as 1.0 only.



3.7.0 Method of Starting

- All the motors shall be suitable for direct on-line starting on full load. Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.
- LT motors rated up to 125 kW shall be controlled through MPCB/MCCB and contactor. LT motors rated more than 125 kW shall be controlled through air circuit breaker.
- HT Motors shall be controlled through vacuum circuit breaker.

3.8.0 Efficiency

All the duty motors shall be energy efficient type. For HT and LT motors, it shall be IE3 class as per IS 12615. For VFD controlled HT and LT motors, it shall be IE2 class as per IS 12615.

3.9.0 Temperature rise

- Winding Insulation shall be Class F.
- Temperature rise of air cooled motors shall not exceed 70°C over air temperature of 50°C by resistance method, while delivering its maximum rated output.
- Temperature rise of water cooled motors shall not exceed 80°C over inlet cooling water temperature by resistance method, while delivering its maximum rated output.

3.10.0 Starting voltage

- a) Motors shall be capable of starting and accelerating the load at following starting voltage, with direct on-line starting, without exceeding specified winding temperatures.
 - HT Motors (up to 1000 kW) : 85% of rated voltage
 - HT Motors (> 1000 kW up to 4000 kW) : 80% of rated voltage
 - HT Motors (> 4000 kW) : 75% of rated voltage
 - LT motors : 80% of rated voltage
- b) During fast changeover of power supply source, vector difference between the motor residual voltage and the incoming supply voltage shall be about 150% of the rated voltage and the motors shall withstand voltage stress and torque stress developed during that time, which may last for a period of one (1) second.
- c) The motor shall be capable of operating at full load at a supply voltage of 75% of the rated voltage for 5 minutes.

3.11.0 No. of Starts

Continuous duty motors shall be suitable for the following starting requirements under the specified conditions of load, torque and inertia.

- No. of consecutive hot starts shall be 2 (with initial temperature of the motor at full load operating level).
- No. of consecutive cold starts shall be 3 (with initial temperature of the motor at ambient temperature).
- For conveyor motors, no. of consecutive hot starts shall be 3 (with initial temperature of the motor at full load operating level).



3.12.0 Starting current

- Locked rotor current of HT motors for applications other than listed below shall be limited to 600% of the full load current, and is subject to IS tolerance.
- For energy efficient LT motors, locked rotor current shall be as per IS: 12615.
- Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance.
- Locked rotor current of the BFP motors shall be limited to 450% of the full load current of the motor, and is subject to IS tolerance.

3.13.0 Locked rotor withstand time

- The locked rotor withstand time for HT motors under hot conditions at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by atleast three seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible. In case the speed switch is required, it shall be indicated by the bidder in his offer
- For the LT motors having starting time up to 20 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than the starting time.
- For the motors having starting time more than 20 seconds and up to 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
- For motors having starting time more than 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- When a speed switch is mounted on the motor shaft, the same shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% over speed in either direction of rotation.

3.14.0 Torque Requirements

- Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- Pull out torque at rated voltage shall not be less than 205% of full load torque.
- Motors subjected to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.

3.15.0 Enclosure

- a) Motors shall have IP 55 degree of protection.
- b) For hazardous location, the enclosure of motors shall following have flame proof construction conforming to applicable standard.
 - Fuel oil area Group – IIB
 - Hydrogen generation plant area : Group – IIC)



3.16.0 Cooling

- LT motors shall be totally enclosed fan cooled (TEFC), type IC411. The cooling shall be effected by self-driven bi-directional centrifugal fan protected by fan cover.
- HT motors can be totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA-IC6A1A1) type.
- Motors rated >3000 kW can be closed air circuit water cooled (CACW).
- Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
 - Hot and cold air temperatures of the closed air circuit for CACA motors.
 - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

3.17.0 Winding

- Winding shall be class F insulation with temperature limited to class B. Insulation shall be Non-hygroscopic, oil resistant, and flame resistant. Winding, fittings and hardware shall be corrosion resistant. Winding shall be tropicalized and suitably varnished, baked and treated for operating satisfactorily in humid and corrosive atmosphere.
- For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.
- Space heaters rated for 240 V AC, 50 Hz supply shall be provided for motors rated 30 kW and above to maintain windings in dry condition when motor is standstill.
- For HT motors, insulation shall be Vacuum Impregnated (VPI).
- HT motors shall withstand one minute power frequency voltage test or 1.2/50 micro sec lightning impulse Voltage wave of 4U+5 kV (U=Line voltage in kV) test on main insulation as per IEC 600034-15. The coil inter-turn insulation shall withstand steep front impulse withstand voltage as per IEC 600034-15.
- For HT motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum.

3.18.0 Bearings

- Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- Sleeve bearings shall be split type, ring oiled with permanently aligned, close running shaft sleeves. Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with grease nipple and relief holes. For sleeve bearings, the bearing housing shall be preferably in end shield itself.
- Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if anti-friction bearings can take vertical thrust, thrust and guide bearings are not required.



- Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types. For motors rated 30 kW and above re-lubrication facility shall be provided.
- For motor with forced lubrication, a shaft driven oil pump shall be provided along with an electrical auxiliary pump. Alternatively, two motor driven pumps may be provided, one working and one standby. All necessary auxiliaries and accessories shall be provided to complete the system. A pressure gauge and pressure switch for low oil pressure warning and to start the standby oil pump automatically shall also be provided. A motor driven jacking oil pump may be provided, for heavy shaft loads.
- Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.
- Each bearing shall be provided with dial type thermometer.
- For all VFD operated motors shall have insulated bearings to prevent flow of shaft currents.
- For motors rated above 1000 KW having shaft length more than 1.5 M shall have insulated bearings to prevent flow of shaft currents.
- All the motors rated <15 kW shall be provided with sealed ZZ bearings.
- Lub oil pressure transmitters shall be provided to DCS for remote monitoring. Lub oil pressure very low trip to HT equipment shall be 2 out of 3 logic.

3.19.0 Terminal Boxes

- Separate terminal boxes of IP 55 degree of protection shall be provided for stator leads. For single core cables, gland plate shall be non-magnetic material. Terminal box of HT motors shall be capable of being turned 360° in steps of 180°. Terminal box of LT motors shall be capable of being turned 360° in steps of 90°. The terminal boxes shall be split type with removable cover with access to connections.
- Terminals for motors shall be stud type, thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- The terminal box shall be capable of withstanding maximum system fault current for 0.2 sec for all breaker operated motors and shall be provided with explosion vent.
- For contactor operated LT motors, the terminal box shall be capable of withstanding the fault current for 0.2 sec minimum and operating time of MPCB/MCCB.
- Removable gland plates of thickness not less than 2.5 mm sheet steel or 3 mm aluminium (for single core cables) shall be provided for cable boxes.
- Cable spreader box shall be provided for larger cable sizes.
- Cable boxes of HT motors shall be phase segregated type. The terminals of three phases shall be segregated by barriers of metal or fiber glass. For HT motors, cable box design shall be suitable for accommodating cable termination kits.
- Separate terminal box for space heaters shall be provided.
- A separate terminal box of IP 55 degree of protection shall be provided for temperature detectors.
- Motors rated >1000 kW shall be provided with neutral current transformers of PS class on each phase for differential protection in neutral side terminal box. The three phases shall be connected to form the star point after passing through the CTs. The CT details shall be



finalized during detail engineering. Neutral terminal box shall have IP 55 degree of protection.

- The secondary leads of CT shall be wired to separate auxiliary terminal box of IP 55 degree of protection
- All the accessory terminal boxes shall be located on the same side of the main (power) terminal box.
- For LT motors, terminal box shall be located on top, unless otherwise specified.

3.20.0 Earthing Terminals

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer. The terminal box shall have a separate grounding terminal.

3.21.0 Noise and Vibration

- Motors shall be selected with low noise levels in accordance with IS 12065.
- The peak amplitude of the vibration shall also be within the specified limits of IS: 12075.
- All HT motors shall be provided with vibration pads for mounting vibration detectors.

3.22.0 Name Plates

Motor shall have stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / IS: 12615 and shall also have 'BEE' marking.

In addition to the minimum information required by IEC/IS, the following information shall be shown on motor rating plate:

- Temperature rise in °C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

3.23.0 Canopy

Canopy shall be provided for all the motors located outdoor. For details, please refer Civil section.

4.0.0 DC MOTORS

DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation.

5.0.0 INSTALLATION

Installation shall be carried out as per IS: 900.

6.0.0 PAINTING

Painting shall be carried out by an approved process. Pretreatment shall conform to applicable standard. The equipment shall be subject to a coat of red oxide primer paint. All inside and



outside surface shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 100 microns. Finish shade shall be 631 of IS: 5 (smoke grey).

7.0.0 TESTING AND INSPECTION

7.1.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished for the motors rated 30 kW and above.

7.2.0 The following type tests shall be conducted on LT motors.

- Measurement of resistance of windings of stator and wound rotor.
- No load test at rated voltage to determine input current power and speed
- Full load test to determine efficiency power factor and slip.
- Temperature rise test.
- Momentary excess torque test.
- High voltage test.
- Test for vibration severity of motor.
- Test for noise levels of motor
- Test for degree of protection
- Over speed test.

7.3.0 The following additional type tests shall be conducted on HT motors.

- No load saturation and loss curves up to approximately 115% of rated voltage
- Measurement of noise at no load.
- Momentary excess torque test
- Full load test
- Temperature rise test at rated conditions.
- Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15
- Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC 60034, part-15
- Degree of protection test for the enclosure followed by IR, HV and no load run test.
- Terminal box-fault level withstand test for each type of terminal box.

7.4.0 The following routine tests shall be carried out for the motors as per applicable standards.

- IR of Winding before and after HV tests
- HV test on main winding space heater, RTD, BTD
- Resistance measurement
- No load run test Major Electrical
- Phase sequence and direction of rotation
- Vibration check Major Electrical
- Reduced voltage running test
- Locked rotor test at reduced voltage
- Record of RTD & BTD resistance at the end of no load test
- Test on space heater & RTD
- Visual Control of terminal box and verification of construction with respect to short tested terminal box

7.5.0 The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

- Measurement of vibration.
- Measurement of insulation resistance and polarization index.
- Measurement of full load current.
- Test running of the motors, checking the temperature rise and identifying the hot spot etc.



8.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Motor sizing calculation
- Technical particulars
- General arrangement drawings
- Performance curves (Efficiency, power factor, starting current)
- Characteristic curves (Speed torque, Hot/cold with stand time, Negative sequence current)
- Terminal box details
- Test reports
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SECTION-3.25: CABLE TRAYS, SUPPORTS & ACCESSORIES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Cable trays & accessories.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) Ladder type Cable trays
- b) Perforated type Cable trays
- c) Cable troughs
- d) Cable Tray bends, Tees, Cross, Coupler plates, etc.
- e) Cable tray covers
- f) Bolted (Unistrut type) cable tray support system
- g) Erection hardware
- h) Consumables
- i) Tools & tackles
- j) Any other equipment required for the system

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Indian Standards, except where modified and /or supplemented by this specification.

- a) IEC: 61537 Cable tray systems.
- b) IS: 1079 Specification for hot rolled carbon steel sheet and strip.
- c) IS: 1730 Dimensions for steel plates, sheet strips and flats for general engineering purposes.
- d) IS: 1363 Hexagon head bolts, screws and nuts.
- e) IS: 6005 Code of practice for phosphating iron & steel.
- f) IS: 2629 Recommended practice for hot dip galvanising on iron and steel.
- g) IS: 2633 Methods for testing uniformity of coating on zinc coated articles.
- h) IS: 6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.
- i) IS: 816 Code of practice for use of metal arc welding for general construction of mild steel.
- j) IS: 4759 Specification for hot-dip zinc coatings on structural steel and allied products

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Cable Trays

4.1.1 Cable trays shall be ladder type for power and electrical control cables and perforated type for signal cables, prefabricated, made out of hot / cold rolled mild steel sheets complete with matching fittings, accessories and hardware as required. Cable trays shall be with standard width of 150 mm, 300 mm, 450 mm, 600 mm, 750 mm and 900 mm and standard lengths of 2.5 metre or more. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. For ladder trays, rung spacing shall be 250 mm maximum. The thickness of side coupler plates shall be minimum 2 mm and of tray covers shall be minimum 1.6 mm.

4.1.2 In corrosive areas, FRP cable trays shall be provided in general.



4.1.3 FRP cable trays also shall be provided for the following areas

- Water Treatment Plant
- Coal Handling Plant
- Sea Water intake system
- Interplant cable trays

4.1.4 Separate cable trays shall be provided for the following cables:

- HT Cables
- LT power cables
- Electrical Control cables
- Signal cables
- Fiber optic cables

Cable trays shall be designed to cater to a load of minimum 75 kg/m.

4.1.5 Cable trays shall be complete with matching fittings and accessories (like elbows, bends, reducers, tees, crosses, side coupler plates, etc.) and hardware (like bolts, nuts, washers, etc.) as required. At both the ends of cable trays, four holes shall be provided for fixing side coupler plates. All the slots and coupler holes shall be machine punched.

4.1.6 Cable trays, fittings and accessories and covers shall be hot dip galvanized. Thickness of galvanizing shall be not less than 610 grams/sq.m. Fasteners like bolts, nuts; screws washers etc. shall also be hot dip galvanized.

4.1.7 For branch cabling routes involving fewer cables, sheet steel galvanized cable trough of size 50/75/100 mm shall be provided.

4.1.8 Cable tray covers shall be provided for horizontally laid outdoor trays, on top most trays. It shall be prefabricated made out of hot/cold rolled mild steel sheets, complete with hardware as required. Special clamps shall be provided for fixing tray covers without drilling holes on trays.

4.2.0 Cable Tray Support System

4.2.1 Cable tray supports shall be of prefabricated preformed sections of sheet steel, bolted type and shall be hot dip galvanized.

4.2.2 Cable tray support system shall be similar or equivalent to "Unistrut make". Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of following two types:

- Single channel strut support for supporting cable trays on one side
- Double channel strut support for supporting cable trays on both sides

4.2.3 Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

4.2.4 The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware fittings and accessories shall be prefabricated factory galvanised.

4.2.5 The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. of the components shall not be allowed.



- 4.2.6 All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.
- 4.2.7 The typical arrangement of flexible support system shall comprise the following:
- 4.2.8 The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- Cantilever arms of required length to match cable tray width. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
 - The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only.
 - Main support channels may be supplied in any suitable lengths to minimize the wastage. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified.
- 4.2.9 Thickness of galvanizing on steel sections shall be not less than 610 gm/sq.m on all steel sections.
- 4.2.10 Horizontally running cable trays shall be clamped by bolting to cantilever arms at an interval of 1500 mm for outdoor and 2000 mm for indoor locations. Vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000 mm.
- 4.2.11 The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm.

5.0.0 TESTS

Equipment offered shall be type tested and proven type. Tests shall be carried out for galvanizing thickness of trays and supports. Load test shall be carried out for trays and supports.

Load Test for Cable trays shall be carried out as follows:

A 2.5 metre straight section of each type of cable tray shall be simply supported at the two ends. A uniformly distributed load of 100 kg per meter shall be applied along the length of tray. The maximum deflection at mid span shall not exceed 7 mm.

6.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- General arrangement drawings for trays and fittings
- General arrangement drawings for support system
- Technical data sheet
- Test reports
- Installation details
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SECTION-3.26: CABLING ACCESSORIES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cabling accessories.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) Cable joints & terminations
- b) Cable glands
- c) Cable lugs
- d) Camps
- e) Tags
- f) Conduits & Pipes
- g) Junction boxes
- h) Consumables
- i) Tools & tackles
- j) Any other equipment required for the system

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Standards except where modified and /or supplemented by this specification.

- a) VDE 0278 Joints and Terminations
- b) IS: 13573 Joints and Terminations for polymeric cables for working voltages from 6.6 kV up to and including 33 kV-Performance requirements and type tests.
- c) BS:6121 Mechanical cable glands (Part 1 -Specification for metallic glands)
- d) IS: 12943 Brass Glands for PVC Cables
- e) IS: 8309 Specification for compression type tubular terminal ends for aluminium conductors of insulated cables.

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Joints & terminations

- 4.1.1 Termination and jointing kits shall be of proven design and make which have already been extensively used and fully type tested. Kits shall be complete with all accessories and consumables required for complete termination or jointing. Copper cable lugs & jointing ferrules for straight through joints shall form part of the kit.
- 4.1.2 Termination and jointing kits shall be suitable for the following types of cables as per IS.
 - 19/33 kV earthed grade cable
 - 11/11 kV unearthed grade cable
 - 6.6/6.6 kV unearthed grade cable
 - 1.1 kV grade power cables
- 4.1.3 Termination kits shall be 'elastimold' or 'Push on type' or 'heat shrinkable type'.
- 4.1.4 Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length. Jointing kits shall be 'heat shrinkable type'.



4.1.5 Straight through joint and termination shall be capable of withstanding the fault level of 50 kA for 11/11 kV cables and 31.5 kA for 6.6/6.6 kV Cables and 25 kA for 33 kV cables.

4.1.6 Straight through joints shall be protected against mechanical damage, rodent and termite attack. It shall be suitable for directly buried cables.

4.2.0 Cable glands

Cables shall be terminated using cable glands suitable for the voltage grade of cables. Cable glands shall be heavy duty brass machine finished and tinned. Cable glands shall be supplied with neoprene seal and earth lugs suitable for the fault capacity of the armour of the installed cables. Cable glands shall be double compression, weather proof type for armoured cables. For flame proof equipment cable glands shall be of flame proof type

4.3.0 Cable lugs

4.3.1 Cable lugs shall be of aluminium for aluminium cables and tinned copper for copper cables. Thickness of tinning shall be not less than 10 microns Type of end connection shall be solder less crimping type.

4.3.2 Cable lugs for conductors of power cables shall be "heavy duty" long barrel type. The type & size of cable lugs for power cables shall be selected according to the number and sizes of strands of the cable.

4.3.3 Solder less crimping of terminals shall be done by using corrosion inhibiting compound. Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ ring type/U Type to suit the terminals provided in the panels.

4.3.4 Type of cable lugs shall be as follows:

- | | |
|---|--------------------------------------|
| • Power cables with aluminium conductor | : Aluminium crimping type. |
| • Power cables with copper conductor | : Copper crimping type. |
| • Control Cables | : Copper pin type /Copper screw type |
| • Special cables | : pin type / maxi-termi type |

4.4.0 Trefoil Cable Clamps

- Clamps required for single core cables carrying alternating current shall be suitable for holding three cables together in delta formation. Clamps shall be of FRP material.
- Clamps shall be of suitable sizes to firmly hold the cables of various outer diameters including tolerance in OD.
- Clamps should have been type tested for Short Circuit Withstand Test.
- For Trefoil clamps run spacing shall be 2000 mm and axial spacing shall be double the diameter of larger adjacent trefoils cable or 150 mm whichever is less. Supports shall also be provided at each bend

4.5.0 Omega Cable clamps

- Omega clamps shall be of galvanized mild steel and shall be used to fasten the individual multi-core cables.
- Clamps shall be of simple construction, made of 2 mm thick, 25 mm wide strip of omega shape and suitable for clamping on the rungs / perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different outer diameters of cables. Omega cable clamps shall be used for individual cables above 35 mm outer diameter.



- Steel clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre
- For cables of above 35 mm OD, cables shall be individually clamped at 5000 mm interval for Horizontal runs and shall be individually clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables of up to 35 mm OD, cables shall be collectively clamped at 5000 mm interval for Horizontal runs and shall be collectively clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables supported along structures/ceiling, clamp spacing shall be 750 mm. Supports shall also be provided at each bend.

4.6.0 Strip Cable Clamps

- Strip clamps shall be of galvanized mild steel and shall be used to fasten the group of multi-core cables up to 35 mm diameter only on a full or part of the tray width.
- Clamps shall be of simple construction, made of 3 mm thick Steel, 25 mm wide strip to cover the entire width up to 300 mm wide tray and part of the tray for more than 300 mm wide trays. Strip shall have two right angle bends at each end for fixing on to the rung/perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different sizes of tray width. However, the maximum size of clamp shall be 300 mm and for cable trays of greater width, two clamps shall be used.
- Clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre

4.7.0 Self-locking Clamps

- Clamps shall be of FRP material. Clamps shall have self-locking feature when the cord is looped. Clamps shall be provided with manual lock release.
- Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.
- Type test certificates to ascertain the strength of clamps shall be submitted for Owner's approval.
- Not more than four (4) cables shall be clamped together, wherever collective clamping is permitted.
- Clamp length shall be selected such that not more than 80% of lockable length is utilised for clamping.
- Nylon self-locking tie strips for collective clamping (up to 35 mm OD max. group of 4 cables) shall be 4 mm having Tensile strength 30 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 35 mm OD up to 55 mm OD) shall be 4 mm having Tensile strength 20 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 55 mm OD) shall be 7 mm having Tensile strength 60 kg.

4.8.0 Tags

- Cables shall be provided with cable number tags for identification.
- Cable tags shall be of aluminium.
- Cable numbers shall be engraved type
- Tags shall be of durable quality of size 60 mm x 12 mm with a tie hole at each end.
- Samples of tags shall be approved by the Owner before delivery.
- Tags shall be provided with non-corrosive wire of sufficient strength for tagging.



4.9.0 Junction Boxes

- 4.9.1 Junction box with IP 55 degree of protection shall comprise of a case with hinged door constructed from FRP material. The junction box shall be provided with canopy. The boxes shall include brackets, bolts, nuts, screws, glands, lugs, M8 earthing stud etc.
- 4.9.2 Terminal blocks shall be of 650 Volt grade, rated for 10 A and in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminal numbering on wiring diagrams. Terminal block shall be suitable for terminating 2Cx2.5mm² cable on both sides and arranged to facilitate easy termination. Cable entry shall be from bottom.
- 4.9.3 The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable / conduit entry knockouts and terminals.

5.0.0 TESTS

Equipment offered shall be type tested and proven type. Test reports shall be submitted for review. For junction boxes degree of protection test shall be carried out.

6.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- General arrangement drawings
- Technical data sheet
- Test reports
- Installation details for junction boxes
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SECTION - 3.24: CABLES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cables.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) 19/33 kV grade XLPE insulated armoured FRLS power cables
- b) 11/11 kV grade XLPE insulated armoured FRLS power cables
- c) 6.6/6.6 kV grade XLPE insulated armoured FRLS cables
- d) 1.1 kV grade XLPE insulated armoured FRLS cables
- e) 1.1 kV grade XLPE insulated armoured FRLS control cables
- f) Trailing cables
- g) Shielded cables
- h) Telephone cables
- i) Fiber optic cables

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and / or supplemented by this specification.

- | | |
|---------------------|--|
| a) IS: 3975 | Mild steel wires formed wires and tapes for armouring of cables. |
| b) IS: 4905 | Methods for random sampling. |
| c) IS: 5831 | PVC insulation and sheath of electric cables. |
| d) IS: 7098 Part-I | Cross-linked polyethylene insulated PVC sheathed cables (LV) |
| e) IS: 7098 Part-II | Cross-linked polyethylene insulated PVC sheathed cables (HV) |
| f) IS: 8130 | Conductors for insulated electric cables and flexible cords. |
| g) IS: 10418 | Drums for electric cables. |
| h) IS: 10810 | Methods of tests for cables. |
| i) IS: 3961 | Recommended current ratings for cables |

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Power cables shall be provided for the following systems:

- 33 kV earthed system having phase fault current and earth fault current of 25 kA.
- 11 kV unearthed system having phase fault current of 50 kA and earth fault current of 300 A.
- 6.6 kV unearthed system having phase fault current of 31.5 kA and earth fault current of 300 A.
- 415 V earthed system having phase fault current and earth fault current of 65/50 kA.
- 220 V DC unearthed system having fault current of not less than 25 kA.

4.2.0 Power cables shall be sized to withstand the system fault current for the fault clearing time indicated below:

- Breaker operated Motor feeders and transformer feeders: 0.16 second.
- Breaker operated outgoing feeders: 0.5 second.
- Tie between two switchgear: 0.5 second.
- Incomers: 1 second.



- 4.3.0 Power cables shall be sized to satisfy the following Criteria:
- To withstand specified system short circuit current for the specified fault clearing time.
 - To carry full load current under applicable installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
 - To limit the voltage drop under steady state/transient state conditions to permissible values.
- 4.4.0 Cables shall be armoured type only.
- 4.5.0 Power cables shall be XLPE insulated. Control cables shall be PVC / XLPE insulated.
- 4.6.0 PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250 °C.
- 4.7.0 Cables for 33 kV system shall be rated for 19/33 kV earthed grade, cables for 11 kV system shall be rated for 11/11 kV unearthed grade and Cables for 6.6 kV system shall be rated for 6.6/6.6 kV unearthed grade. Cables for 415/230 V AC and 220 V DC shall be rated for 1.1 kV grade.
- 4.8.0 To minimize the damage that can be caused by a fire, conductors installed in electrical cable tray systems shall have jackets which have non-propagating, and self-extinguishing flame retardant, low smoke (FRLS) characteristics. Outer sheath shall be of PVC black in colour. These cables shall meet the following test requirements.
- Oxygen index of minimum 29 when tested as per IS 10810 Part-58
 - Temperature index of minimum 250°C when tested as per IS 10810 Part-64
 - Acid gas emission of maximum 20% when tested as per IS 10810 Part-59 Average light transmission of 40% minimum when tested as per IS 10810 Part-63 (average smoke density is maximum 60%)
 - Flame test requirements as per IS 10810 Parts-53 and 62
 - Flame retardant test requirements as per IS 10810 Part-61
- 4.9.0 For power cables, copper conductor shall be used for current rating of up to 10 A. For higher current rating, conductor can be aluminium/copper. Minimum size of copper conductor shall be 2.5 sq.mm and aluminium conductor shall be 6 sq.mm.
- 4.10.0 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 2.5 sq.mm copper. Control cables shall have 20% spare cores.
- 4.11.0 Current transformers leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity and knee point voltage. Minimum 2.5 sq.mm copper cables shall be used for connection of CT to load. In case 2.5 sq.mm size impose unacceptably high burden on CTs, 4 sq.mm copper shall be used. Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.
- 4.12.0 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc.
- 4.13.0 Design ambient air temperature and ground temperature shall be considered at 50°C and 40°C respectively for cable sizing.
- 4.14.0 For 11 kV & 6.6 kV cables, screen of each core shall be sized to withstand 300 A for 1 sec. For 33 kV cables, screen of each core shall be sized to withstand system earth fault current for 0.16 sec.



- 4.15.0 For HT motors the voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 2.5% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5% of rated voltage
- 4.16.0 For LT motors the voltage drop in the cable, during motor starting condition, shall be limited to 15% and during full load running condition, shall be limited to 3% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 6% of rated voltage.
- 4.17.0 Cables for the following systems shall be fire survival type.
- DC emergency lube oil pumps
 - DC seal oil pump
 - DC emergency lighting cables for main building.
 - Batteries to chargers and DC distribution boards
 - Turbine lub oil pumps
 - Jacking oil pumps
 - Emergency turbine trip by push button in control room
 - Inter trip cables between Boiler master fuel trip and turbine trip relays
 - Inter trip cables between Generator trip relays and turbine trip relays/400 kV circuit breaker/generator field breaker/UT breakers
- 4.18.0 Method of curing for HT XLPE insulation shall be **gas/steam curing**.
- 4.19.0 Conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied with XLPE insulation in one operation through triple extrusion.
- 4.20.0 For armoured cables, armouring shall be of aluminium for single core cables. For multicore armoured cables, armouring shall be of galvanised steel.
- 4.21.0 All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added into the PVC compound of the outer sheath. The sheath shall be resistant to water, UV radiation, fungus, etc.
- 4.22.0 Multi-core cable color coding shall be as follows:
- Red, yellow, blue, black and gray for five core cables
 - Outer sheath shall be of black in colour.
 - For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
- 4.23.0 Three core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:
- Circular stranded and compacted aluminium conductor
 - Extruded semi conducting compound as conductor screen
 - Extruded XLPE insulation
 - Extruded semi conducting compound as insulation screen
 - Copper tape as metallic screen for each core
 - Extruded PVC inner sheath
 - Galvanised steel formed wire/strip
 - Extruded FRLS PVC outer sheath
- 4.24.0 Single core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:
- Circular stranded and compacted aluminium conductor
 - Extruded Semi conducting compound as conductor screen
 - Extruded XLPE insulation
 - Extruded Semi conducting compound as insulation screen
 - Copper tape as metallic screen
 - Hard drawn aluminium wire armour
 - Extruded FRLS PVC outer sheath



4.25.0 Multicore 1.1 kV earthed grade cables shall constitute the following:

- Circular / shaped, stranded aluminium conductor (compacted for >10 sq.mm)
- Extruded XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.26.0 Single core 1.1 kV earthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded XLPE insulation
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

4.27.0 **Trailing power and control cables for mobile equipment shall constitute the following:**

Unearthed grade HT power cables, earthed grade LV power cables and control cables shall be flexible trailing with annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed. For HT cables, insulation screen shall be provided. Cables shall conform to applicable IS/IEC standard requirements.

4.28.0 **Fire survival cables**

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica taped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

4.29.0 Multicore 1.1 kV earthed grade control cables shall constitute the following as per IS:1554-1 / 7098-1:

- Multi stranded annealed copper conductor
- Extruded PVC / XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.30.0 Multi pair 1.1 kV earthed grade, overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.31.0 Multi pair 1.1 kV earthed grade, individual and overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair



- Individual polyester taped, Al-mylar screened with ATC drain wire
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.32.0 Cable drums

Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. All wooden parts shall be manufactured from durable quality wood duly seasoned and treated with copper nepthenates or zinc nepthenates for preserving the wood. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418.

4.33.0 Cable identification system

- a) In addition to manufacturer's identification on cables as per IS, following marking shall also be embossed/printed on the outer sheath at an interval of one metre throughout the length of cables.
 - BIS mark
 - Manufacturer's name and or trade mark.
 - Year of manufacture
 - Cable code
 - Type of cable and voltage class.
 - Nominal cross section area of conductor and no.of cores.
 - Progressive sequential length making.
- b) Cables shall be marked as having FRLS outer sheath at every 5 meters.
- c) The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.
- d) Multi-core cable color coding shall be as follows:
 - Red, yellow and blue for three core cables
 - Outer sheath shall be of black in colour.
 - For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
 - For multi pair cables, each pair shall be coloured and numbered.

5.0.0 TESTS

Cables offered shall be type tested and proven type. Routine tests shall be carried out on 100% drums. Type tests, special tests and acceptance tests shall be carried out on 1 drum selected on random basis, out of every 10 or less number of drums of each type and size of cable of each lot. Size shall mean area of cross section in sq.mm read in conjunction with the number of cores. Type shall mean type of insulation, sheath, volt grade FRLS/FS etc.

5.1.0 Type Test

- a) Tests on conductor



- i) Annealing Test (for copper)
- ii) Tensile test (for aluminium)
- iii) Wrapping test (for aluminium)
- iv) Resistance test

- b) Tests for armour wires/strips
- c) Tests for thickness of insulation and sheath
- d) Physical tests for insulation
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot test
 - v) Water absorption (gravimetric)
- e) Physical test for outer sheath
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - iv) Hot deformation
 - v) Heat shock test
 - vi) Loss of mass test in air oven
 - vii) Thermal heat stability test (as per IS : 5831)
 - viii) Bleeding and blooming test
- f) Anti-termite and anti-rodent test (on outer sheath).
- g) Partial discharge test
- h) Bending test
- i) Dielectric power factor test
 - i) As a function of voltage
 - ii) As a function of temperature
- j) Insulation resistance (volume resistivity) test
- k) Heating cycle test
- l) Impulse withstand test
- m) High voltage test
- n) Flammability test
- o) Cold impact test

5.2.0 Acceptance Test

- a) Annealing test (for copper)
- b) Tensile test (for aluminium)
- c) Wrapping test (for aluminium)
- d) Conductor resistance test
- e) Test for thickness of insulation and sheath
- f) Hot set test for insulation
- g) Tensile strength and elongation at break test for insulation and outer sheath
- h) Partial discharge test (for screened cables)
- i) High voltage test
- j) Insulation resistance (volume resistivity) test

5.3.0 Routine Test

- a) Conductor resistance test
- b) Partial discharge test



- c) High voltage test

5.4.0 Special Test

- a) Oxygen index test as per IS 10810 Part-58
- b) Temperature index test as per IS 10810 Part-64
- c) Acid gas generation test as per IS 10810 Part-59
- d) Smoke generation test as per IS 10810 Part-63
- e) Flammability tests as per IS 10810 Parts-53 and 62
- f) Flame retardant test as per IS 10810 Part-61

5.5.0 Site Test

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

- a) Insulation resistance test
- b) High voltage test

6.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SECTION-3.29: ELECTRICAL INSTALLATION

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Electrical installation and also supply and installation of the following items:

- Rubber mats for switchgear
- Caution boards
- Sand buckets
- First aid box
- Sheet steel cover for /cable shaft/trench etc.
- Sheet steel hood for the outdoor electrical equipment/motor
- Cable route markers & Cable joint markers
- Shock hazard chart
- Erection hardware

2.0.0 CODES AND STANDARDS

Installation of cabling work shall comply with the latest edition of following Indian standards, rules, regulations and acts.

- IS: 1255 : Code of practice for installation and maintenance of power cables up to and including 33 kV rating.
- IS: 732 : Electrical wiring installation (system voltage not exceeding 650 V).
- IS 10028 : Code of Practice for selection, Installation & maintenance of transformers.
- IS 10118 : Code of practice for selection, installation & maintenance of Switchgear & Control gear.
- IS: 5216 : Guide for safety procedures and practices in electrical works.
- IS 2551 : Danger notice plates
- IS 8923 : Warning Symbol for dangerous voltages.
- Indian Electricity Act.
- Indian Electricity Rules.
- Fire insurance regulations.
- Regulations laid down by the Chief Electrical Inspector of the State.
- Regulations laid down by the Factory Inspector of the State.

3.0.0 GENERAL REQUIREMENTS

- 3.1.0 The work shall be carried out in the best workman like manner in conformity with the latest editions / amendments of relevant specifications / codes / standards / regulations.
- 3.2.0 Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, erecting, testing and commissioning of all items / equipment and care shall be exercised in handling to avoid distortion to stationary structures, marring to finish, or damaging of delicate instruments or other electrical parts.
- 3.3.0 All the equipment covered under this specification shall be installed in neat, professional manner such that the structures and equipment are level, plumb, squat, properly aligned and oriented. Clearance around electrical panels / equipment shall be as per relevant standards.
- 3.4.0 The Contractor shall effectively protect his work, equipment and materials under his custody from theft, damage or tampering. Finished work where required shall be suitably covered to



keep it clean and free from defacement or injury. Contractor shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to Contract.

- 3.5.0 All safety rules and codes as applicable to work shall be followed without exception. All safety appliance and protective devices including belts, hand gloves, aprons, helmets, shields, goggles, safety shoes etc. shall be provided by the Contractor for his personnel.
- 3.6.0 The Contractor shall provide guards and prominently display caution notices if access to any equipment / area is considered unsafe and hazardous. In order to avoid hazards to personnel moving around the equipment such as switchgear etc. which is kept charged after installation, before commissioning, such equipment shall be suitably cordoned off to prevent anyone accidentally going near it.
- 3.7.0 The Contractor shall have a separate cleaning gang to clean all equipment under erection as well as the work area and the project site at regular intervals to the satisfaction of Owner. In case this is not done, the Owner shall have the right to carry out the cleaning operation and any expenditure incurred in this regard shall be to the Contractor account.
- 3.8.0 The Contractor shall ensure that instruments and gauges to be used for testing and inspection have valid calibration and the accuracy can be traced to National Standards.
- 3.9.0 It shall be the Contractor's responsibility to obtain approval from local statutory authorities including Electrical Inspector / CEA, wherever applicable, for carrying out any work or for installation carried out which comes under the purview of such authorities. All such documents and original certificates shall be handed over to Owner which then shall be property of the Owner.
- 3.10.0 The installation shall be carried out only by electrical Contractor, holding a valid license, issued by relevant authorities for carrying out installation work of the voltage classes involved, under the direct supervision of a person holding valid certificates of competency for the same voltage classes, issued or recognized by the state Government.
- 3.11.0 The installation shall have to be approved by statutory government authorities like Electrical Inspector, Factory Inspector, Insurance Officials etc. It shall be the responsibilities of Contractor to prepare and submit all necessary drawings, calculations and test certificates to electrical inspectorate and obtain approval/certification prior to installation and commissioning work and also arrange inspection by them after installation.

Necessary fees and other charges for the same shall be paid by Contractor.

- 3.12.0 Contractor shall take utmost care in holding instruments, relays and other delicate mechanisms wherever these are supplied separately. They shall be installed only after the associated panels have been erected and aligned. The packing materials employed for safe transit of these shall be removed after ensuring that panel have been completely installed and no further movement of the same are necessary. Any damage shall be immediately reported to Owner.
- 3.13.0 All the electrical equipment, panels, motors, busduct, cables etc. shall be stored under covered shed and oil filled power transformers can be stored outdoor. The OEM recommendation for electrical equipment shall be strictly adhered and proper periodical record shall be maintained, which shall be inspected by Owner.

4.0.0 CABLING CONCEPT

- 4.1.0 Cabling installations shall be carried out on trays. In all electrical rooms and control rooms, cable spreader room shall be provided. A clear working space of 800 mm shall be provided



horizontally between trays and on either side of the trays. A clear head room clearance of 1800 mm shall be provided in the cable spreader room.

- 4.2.0 In transformer yard and outdoor switchyard, cables shall be laid in cable trenches. Cable trenches shall have cable trays installed at a vertical spacing of 300 mm between the trays and supported at every 1500-2000 mm to trench wall. Cables shall be laid on trays only. Separate trays shall be provided for each of HT, LT, Control, signal cables. In the cable trench, a clear working space of atleast 600 mm shall be provided adjacent to trays. Cable trenches shall be properly sloped and connected to sump. For Cabling from equipment to trenches, GI pipe can also be used.
- 4.3.0 For short cable runs in auxiliary plant areas local to equipment shall be laid in floor slits up to near the equipment. Cable trenches are not permitted in other areas.
- 4.4.0 In the plant buildings and structures cables shall be laid overhead suitably supported on along wall/structures.
- 4.5.0 All interplant cable tray routing shall be on overhead cable trestles or combined with pipe trestles in a separate tier..
- 4.6.0 Cable routes shall be segregated unit wise, to the extent possible. Similarly, cables for the standby drives shall preferably be taken through the alternative route. Separate routes shall be considered for duplicate control supply cables, first and second channel protection cables, and cables to common station service of two or more units.
- 4.7.0 Cables shall be avoided below oil pipes and in the vicinity of steam pipes.
- 4.8.0 Cable trays shall be laid in vertical formation in boiler, mill and ESP areas to avoid accumulation of coal-dust / ash on cables and cable-trays.
- 4.9.0 Cables shall not be routed in coal conveyor gallery, a separate cable gallery shall be provided.
- 4.10.0 In cable trenches, pipe racks/ cable racks, overhead routes, cable shafts and cable spreader rooms, cables shall be laid in cable trays only. Fewer cables installed along buildings, structures, ceilings, walls, etc., which are required to be protected against mechanical damage, shall be taken in GI conduits.
- 4.11.0 GI Conduits shall be used for flameproof installations, wherever required, with sealing at both ends.
- 4.12.0 Entry of cables from trenches into buildings shall be atleast 300 mm above finished ground level.
- 4.13.0 Where direct heat radiation from equipment/pipes exists, heat isolating barriers for cabling system shall be adopted.
- 4.14.0 Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth.
- 4.15.0 At certain places where leakage of oil or other hazardous material may cause damage to the cables, cable trenches/slits may be sand-filled, after installation of cables.
- 4.16.0 In corrosive atmosphere, PVC conduits shall be used for routing cables. Metallic pipes / conduits shall not be used in corrosive areas.
- 4.17.0 Three phase AC single core cables, while laying in steel conduits, shall be laid in trefoil formation only.



- 4.18.0 Complete cable tray & accessory installation work shall be inspected for proper alignment, leveling (by use of plumb lines), use of proper accessories, provision of proper bending radius and high quality workmanship.
- 4.19.0 Cable trays shall be ladder type for power and electrical control cables, while perforated type cable trays shall be used for instrumentation and control cables. However, in vertical cable tray risers, all trays shall be ladder type.
- 4.20.0 Flexible conduits shall be used between fixed conduits and equipment terminal boxes, where vibration is anticipated.
- 4.21.0 Junction boxes shall be installed so that they are level, plumb & properly aligned and present a pleasing appearance. Boxes shall be adequately supported by means of proper supporting arrangement.

5.0.0 CABLE TRAY AND SUPPORT SYSTEM INSTALLATION

- 5.1.0 Cable trays shall be bolted to tray mounting supports with a minimum clearance of 300 mm between cable tray tiers / as shown in the drawings.
- 5.2.0 For horizontal runs in door and in trenches, cable trays shall be supported at an interval of 1500 mm and for outdoor installation it shall be 2000 mm. For vertical cable risers/shafts cables shall be supported at every 1000 mm interval.
- 5.3.0 Support system shall be so designed that it is able to withstand weight of the cable trays, weight of the cables (75 Kg/metre run for each cable tray), concentrated load of 75 Kg between every support span without any permanent deflection. Factors of safety of atleast 1.5 shall be considered.
- 5.4.0 Cable tray supports shall be of bolted (similar to Unistrut) type, which shall be installed at site, by bolts. Fixing of tray supports by welding is not allowed. Cable tray support structure shall be bolted to the steel structure by clamping and to concrete structures by embedding or using anchor fasteners.
- 5.5.0 All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 60 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted / stenciled with identification numbers at every floor.
- 5.6.0 Tray covers shall be provided for outdoor overhead cable trays on top most tiers. Tray covers shall be provided for top tray of horizontal tray runs located under grating floor or insulated piping, and for all trays routed in areas where oil might enter or accumulate. The cable risers or vertical raceways shall also be covered by cable tray covers up to 1.5 metres from respective floor for mechanical protection. The tray cover shall be of galvanized sheet steel, removable type.
- 5.7.0 Atleast 250 mm spacing shall be maintained between top of the trays and beams/piping etc..
- 5.8.0 **Typical cable tray installation details are shown in the drawings enclosed in Section-7 of Volume-II.**

6.0.0 CONDUITS/PIPES/DUCTS INSTALLATION

- 6.1.0 Rigid steel conduits shall be used indoors in non-hazardous areas. Unplasticised PVC conduit shall be used for duct banks and for some below grade concrete encased conduit.



- 6.2.0 Exposed conduits shall be routed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical conduit bends or fittings. Conduits shall be securely supported within 900 mm of connections to boxes and cabinet.
- 6.3.0 Embedded conduits shall have a minimum concrete cover of 50 mm. All conduits to be embedded in concrete shall be inspected to ensure continuity and accuracy of placement before concrete is poured. All embedded pipes/conduits, sleeves, long radii bends etc. shall have at least 50 mm long extension beyond the embedded part, for extension of the same or for providing end plugs. If any embedded conduit is not required, it shall be plugged/sealed. All accessories/fittings required for making the installation complete, shall include tees, elbows, check nuts brass or galvanized steel end caps, PVC/brass bell mouths for water proof sealing, pull boxes, saddles, spacers and required steel supporting work.
- 6.4.0 Flexible conduit shall be terminated using suitable end coupler and check nut at both ends.
- 6.5.0 All conduits installed outdoor shall be sloped towards pull boxes, hand holes/manholes for drainage. Low points of conduits not terminating in pull boxes, hand holes/manholes shall be provided with weep holes for drainage. Care shall be taken to see that no rough edge is left around the weep holes. Where no provision for drainage can be made, both ends of conduits shall be sealed after cable is laid through. Minimum slopes of 1 in 400 shall be provided.
- 6.6.0 Exposed conduit shall be adequately supported by racks, clamps, straps or by other approved means. Conduits supports shall be erected square and true to line and grade. For bending of conduits, bending machine shall be arranged at site by the Contractor to facilitate cold bending. The bends formed shall be smooth.
- 6.7.0 When two lengths of conduits are joined together through a coupling, running thread equal to twice the length of coupling shall be provided on any one length to facilitate easy dismantling. The Contractor shall have at site die for threading pipe or conduit. After threading of conduits anti corrosive paint shall be provided.
- 6.8.0 Occupancy of conduits shall not be greater than 40%.
- 6.9.0 Liquid tight flexible metallic conduit shall be used for connections to solenoid valves, limit switches; pressure switches etc., and for connection to motors or other vibrating equipment and across areas where expansion or movement of the conduit is required.
- 6.10.0 Minimum bending radius for conduits shall be 10 times the external diameter of the conduit.
- 6.11.0 All conduits shall be permanently identified at each end with the conduit number assigned to it as per the applicable drawings.
- 6.12.0 Pull boxes shall be installed between termination points wherever required to facilitate cable out at a maximum interval of 30 metres.
- 6.13.0 Conduits shall be firmly fastened within 900 mm of each junction box, cabinet or fitting. Conduits shall be supported at least every 2000 mm.

7.0.0 CABLE INSTALLATION

- 7.1.0 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. Generally HT cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Separate cable trays shall be used for the following:
- HT Power Cables
 - LT Power Cables
 - Control Cables



- Instrumentation/communication cables
 - Fire Survival cables
- 7.2.0 Single core cable in trefoil formation shall be laid with spacing equal to the diameter of the Trefoils and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be securely fixed to trays /supports with self-locking type nylon cable strap with de-interlocking facility at every 5 meter interval for horizontal run and cables laid in vertical run of trays shall be securely fixed to trays/supports by galvanized steel clamps at every one metre interval. All power cables should be clamped individually.
- 7.3.0 HT cables and LT power cables of >16 sq.mm shall be laid in one layer only. LT power cables of up to 16 sq.mm can be laid in two layers. Control cables can be laid in 3 layers.
- 7.4.0 Bending radii for cables shall be as per manufacturer's recommendations.
- 7.5.0 Where cables cross roads/rail tracks, the cables shall be laid in hume pipes embedded in ground with a minimum cover of 1 metre or with RCC covering for lower depth.
- 7.5.0 In each cable run some extra length shall be kept at suitable point to enable one straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 7.6.0 For Directly Buried cables, construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, concrete protective covering, back filling and compacting, provision of route markers and joint markers. Before the cables are placed, the excavated portion shall be filled with a layer of sand and leveled. The cables laid over it shall then be covered with 150 mm sand on top of the largest diameter cable and sand shall be lightly pressed. A protective covering of concrete shall then be provided on top. The remaining portion of the excavated trench shall then be back filled with soil, rammed and leveled.
- 7.7.0 RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 75 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.
- 7.8.0 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 30 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminium with number punched on it and securely attached to the cable GI wire.
- 7.9.0 Where a cable route crosses a permanent road/railway line cables shall be drawn through hume pipes or G.I. pipes. Pipes should be laid in a straight configuration. Filling criteria in any pipe shall not be more than 40%.
- 7.10.0 Conduits shall be used for routing of cables (power / control) from cable trays to equipment/ junction boxes. Pipe sleeves shall be used for routing of cables between floors, road crossing, entry/exit from outside of building etc. All conduits/pipe shall have their ends closed by caps till the cables are pulled. After the cables are pulled, the ends shall be sealed by suitable sealing compound having 2 hour fire withstand capability.



- 7.11.0 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscriptions "Cable-Joint" and "Cable Number".

8.0.0 CABLE TERMINATION AND JOINTING

- 8.1.0 All cable entries in the equipment shall be sealed by cable glands.
- 8.2.0 Adequate length of cables shall be pulled inside the switchgear, control panels, terminal boxes etc. so as to permit neat termination of each core / conductor.
- 8.3.0 Power cable terminations shall be carried out in a manner such as to avoid strain on the terminals by providing suitable clamps near the terminals.
- 8.4.0 Control cable cores entering switchgear or control panels shall be neatly bunched and strapped with PVC perforated tapes / nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals, wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.
- 8.5.0 Screened control cables of small cross sectional area, shall be terminated by means of Maxi-Termi termination system.
- 8.6.0 Termination and jointing of HT cables shall be done with approved type termination/ jointing kits. Cable joints are permitted, only when the route length exceeds one full drum length.
- 8.6.0 Screened control cables of small cross sectional area, e.g. 0.5 mm², shall be terminated by means of maxi-termi termination system. Contractor shall ensure the availability of all tools, tackles and accessories such as maxi-termi guns, clips, wire etc. required for the termination of small cross section screened control cables by this method. Compressed air supply for maxi-termi guns shall also be the responsibility of Contractor.
- 8.7.0 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per control schemes and other related documents. The spare cores shall be ferruled as spare.
- 8.8.0 Fiber optic termination and splicing equipment shall be used for cutting, finishing and joining fiber optic cables. An optical fiber tool shall be used to slice into the cable's outer coating and unpack the fibers without damaging them. Fiber optic cleaners, cleaning chemicals or solvents and cleaner dispensers shall be used for preparation of the cut and polished joint or splice. Fiber optic cables shall be terminated by using connectors to couple the cable to network devices. Fiber optic connectors shall be specifically designed to limit light loss and provide a secure connection to a device. The fiber optic termination connectors shall have a bayonet mount and a cylindrical ferrule to hold the fiber in place.

9.0.0 OVERHEAD LINE STRINGING WORK

- 9.1.0 Stringing work shall mean the activities of fixing of insulator and insulator hardware, jointing, tensioning, clamping with armour rod, providing dampers, repairing of conductors (if any), fixing the conductor at tension hardware etc.
- 9.2.0 The stringing work shall be carried out with the help of tensioner and puller machine. Manual stringing shall not be allowed. Stringing work shall be carried out as per approved sag tension chart.
- 9.3.0 Sufficient numbers of aluminum snatch blocks shall be used for paying out the conductors. Necessary precautions shall be taken to avoid conductor rubbing on the ground by providing



adequate ground roller, rollers on supports etc. Additional rollers shall also be provided to cross thorny hedges, footing and other obstructions to avoid scratching of conductor.

- 9.4.0 The conductor and earth wire shall be made to sag correctly as per stringing charts, before they are finally transferred to the hardware for conductors and to clamps for earth wire. No joint shall be made at less than 30 m from the tower end and no joint shall be permitted in road and other important crossings spans. There shall not be more than one joint in a span of each conductor.
- 9.5.0 Dynamometers shall be used in tensioning the conductors. All conductors shall be stressed to their maximum working load at the time of stringing, as per approved stringing charts. The minimum clearance between the lowest point of conductor and ground shall not be less than required.
- 9.6.0 The stringing sheaves, when suspended on the transmission structure for sagging, shall be so adjusted that the conductor shall be on the sheaves at the same height as the suspension clamp to which it is to be secured.
- 9.7.0 Proper guys shall be provided to counter balance the paying out tension of conductor / earth wire at the tension locations, to avoid damage to towers and / or accident.

10.0.0 SAFETY REQUIREMENTS

- 10.1.0 Provisions of Indian Electricity Rules in respect of various safety requirements (especially as provided at Rule 29, 35, 36, 42, 43, 44, 64, 74 to 80, 87 & 92) shall be complied with.
- 10.2.0 The minimum safety working clearances shall be maintained for the bare conductors or live parts of any apparatus in outdoor substations as per IE rule 64 a) ii).
- 10.3.0 All practical steps shall be taken to prevent operating the earth moving, lifting and housing machinery in dangerous proximity to a live overhead power line.
- 10.4.0 Barricades or barriers shall be installed to prevent accidental contact with energized lines or equipment. Where appropriate, signs indicating the hazard shall be pasted near the barricade or barrier.
- 10.5.0 Rubber gloves and insulated shoes shall invariably be worn in all cases while operating gang operating switches controlling high tension lines and equipment where accidental contact of operating personnel with live parts are likely. While working near live lines and equipment and working on live low-tension lines and equipment, gloves shall be worn.
- 10.6.0 Safety belts shall invariably be used in all cases while working on overhead systems like lines, bus bars, substation equipment etc.
- 10.7.0 Tested rubber mats shall be kept in front of operating panels / switches etc. They shall be checked for condition periodically and replaced as necessary.
- 10.8.0 First aid box shall be maintained. These shall be checked periodically and refilled or items replaced as necessary.
- 10.9.0 Chart for providing relief and treatment of person electrocuted shall be displayed prominently at suitable places in the substation. These shall be checked for condition periodically and replaced as and when necessary.
- 10.10.0 Firefighting equipment such as fire buckets filled with sand and fire extinguishers for both electrical and oil fires shall be maintained and kept at easily accessible place in substation



- 10.11.0 The Contractor shall supply and install all danger plates as per IS 2551. The danger plates shall be written in Hindi, local language and English and shall be provided as required for all electrical equipment.
- 10.12.0 All safety appliances and protective devices including belts, hand gloves, aprons, helmets, shields, goggles, safety shoes etc. shall be provided by the Contractor for his personnel.
- 10.13.0 The following minimum safety working clearances shall be maintained for the bare conductors or live parts of any apparatus in outdoor substations excluding overhead lines of installations of voltage exceeding 650 volts.

Highest System Voltage (kV)	Safety Working Clearance (Metres)
12	2.6
36	2.8
72.5	3.1
145	3.8
245	4.6
420	6.4

- 10.14.0 The above safety working clearances are based on an insulation height of 2.44 m, which is the height of lowest point on the insulator (where it meets the earthed metal) from the ground.

11.0.0 TESTING AND COMMISSIONING

- 11.1.0 The Contractor shall take full responsibility of testing at erection, pre-commissioning and commissioning stages of all the equipment / system being installed by him. The Contractor shall submit to the Owner a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist. The Contractor shall carry out the commissioning tests and checks after erection at site as per applicable standards and also as recommended by manufacturers.
- 11.2.0 On completion of erection work, the Contractor shall request the Owner for inspection and test. The Owner shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor. The installation shall be then tested and commissioned in the presence of the Owner and put on trial run for stipulated contract period.
- 11.3.0 The Contractor shall arrange for inspection of his installation work by Electrical Inspector and shall obtain necessary approval certificate for his installation work and charging. Any modification work required by Electrical Inspector must be undertaken by the Contractor at his own cost. All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost.
- 11.4.0 Following successful inspection and testing, all the equipment shall be commissioned and put on trial run in a manner mutually agreed upon based on the commissioning schedule.
- 11.5.0 The Contractor shall have to bring all testing equipment and instruments in sufficient numbers to carry out the job simultaneously in more than one area. Tests shall be conducted by qualified and experienced personnel. Valid calibration certificates for the testing equipment shall be produced.
- 11.6.0 All documents / records regarding test data and all other measured values shall be submitted to Owner for approval and subsequent record and reference. The results of all tests shall conform



to the specification requirements as well as any specific performance data guaranteed during finalization of Contract.

- 11.7.0 All checks and tests as per manufacturer's drawings / manuals, relevant codes of installation and commissioning checklists for various electrical equipment such as transformers, breakers, motors, switchgear, relays, meters etc. shall be carried out.
- 11.8.0 The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear / panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g. closing, tripping, control interlock, supervision circuits, alarm circuits etc. All connections in the switchgear shall be tested from point to point for possible earth or phase faults.
- 11.9.0 Contractor shall submit specified copies of site testing procedures, test formats along with details of site test instruments proposed to be deployed at site along with respective valid calibration certificates, six weeks prior to commencement of site testing, for approval by Owner. Only procedures and test formats approved by Owner shall be used for site testing. After completion of commissioning of all equipment and prior to handing over, six sets of such signed test data in the agreed / approved formats shall be furnished prior to issue of provisional acceptance of the equipment / installation.
- 11.10.0 The testing of all electrical equipment as well as the system as a whole shall be carried out at site to ensure that the equipment and its components are in satisfactory condition and shall successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installation conform to the accepted design, engineering and construction standards as well as accepted codes of practice.
- 11.11.0 All tests shall be carried out by the Contractor using his own instruments, testing equipment as well as qualified testing personnel.
- 11.12.0 The results of all tests shall conform to the specification requirements as well as any specific performance data guaranteed during finalization of the Contract.
- 11.13.0 At site, all equipment shall be energized only after certification by the personnel performing the test that the equipment is ready for energizing and with concurrence of the Owner.
- 11.14.0 The various commissioning checks / tests to be carried out shall be in accordance with applicable standards and equipment supplier's recommendation.
- 11.15.0 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

- a. Cables
- Check for physical damage.
 - Check for insulation resistance before and after termination/ jointing.
 - HT cables shall be pressure tested before commissioning.
 - Check of continuity of all cores of the cables.
 - Check for correctness of all connections as per relevant wiring diagrams.
 - Check for correct polarity and phasing of cable connections.
 - Check for proper earth connections for cable glands, cable boxes, cable armour, screens etc.
 - Check for provision of correct cable tags, core ferrules, and tightness of connections.
- b. Cable trays/ supports and accessories



- Check for proper galvanizing/ painting and identification number of the cable trays/ supports and accessories.
- Check for continuity of cable trays over the entire route.
- Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- Check for earth continuity and earth connection of cable trays.

12.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Block diagram for cabling
- Typical details of cabling installation
- Details of cable trays and accessories
- Layout of IPB Busduct , Segregated phase Busduct layout and 415 V NSPB Busduct
- DG Room layout
- Transformer Yard Layout
- Electrical room equipment layout for Power house building
- Electrical equipment layout for ESP building
- Electrical room equipment layout for various auxiliary buildings
- Electrical room equipment layout for non-plant buildings
- Cable Trench layout for Transformer Yard
- Cable routing layout for power house building
- Cable routing layout for Boiler floors
- Cable routing layout for ESP
- Interplant Cable routing layout
- Cable routing layout for Main control building
- Cable routing layout for switchyard and switchyard control building
- Cable routing layout for DG building
- Cable routing layout for all electrical rooms & control rooms
- Cable Routing layout for all plant buildings
- Cable Routing layout for all non-plant buildings
- Cable Schedule for power cables, control cables and signal cables for all Switchgear, equipment and control panels
- Interconnection Schedule for all Switchgear, equipment and control panels
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SECTION-3.28: EARTHING & LIGHTNING PROTECTION SYSTEM

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Earthing & Lightning protection system.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) Buried earth mat for the main plant, auxiliary plants, non plant buildings and switchyard
- b) Embedded earth mat in the concrete floor of buildings, electrical rooms including GIS building.
- c) Equipment enclosure earthing for all electrical equipment
- d) Earthing of all metallic structures including cable racks
- e) Electronic earthing for all DCS/Respective control system/SAS/EMS and other electronic equipment
- f) Earthing for communication system
- g) Lightning protection for GIS building, Switchyard and transformer yard
- h) Lightning protection for main plant building, Boiler, ESP
- i) Lightning protection for Chimney
- j) Lightning protection for Cooling tower
- k) Lightning protection for Ash silo structure
- l) Lightning protection for CHP buildings and structures
- m) Lightning protection for Ash buildings and structures
- n) Lightning protection for all auxiliary plant buildings/structures and outdoor equipment/structures
- o) Lightning protection for all non-plant buildings and structures

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Standards except where modified and /or supplemented by this specification.

- a) IS: 3043 Code of Practice for Earthing
- b) IS: 2309 Protection of building and allied structures against lightning - Code of practice
- c) IS: 1079 Specification for hot rolled carbon steel sheet and strips
- d) IS: 2629 Recommended practice for hot dip galvanizing on iron & steel
- e) IS: 4759 Specification for hot-dip zinc coatings on structural steel and , allied products
- f) IS: 6745 Methods for determination of weight of zinc-coating on zinc coated articles.
- g) IEEE 80 IEEE Guide for safety in AC substation grounding
- h) IEEE 142 Grounding of industrial & commercial power system.
- i) CBIP manual on AC earthing system
- j) Indian Electricity Rules

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Earthing System

- 4.1.1 Earthing system shall be provided for complete power station including switchyard.



4.1.2 Earthing system shall comprise the following:

- Neutral earthing to establish the ground reference of the electrical system
- Safety ground connections for protecting personnel from injury and property from damage
- Equipment earthing to ensure a low impedance return path for ground current should an electrical fault occur between the live conductors and the equipment enclosure

4.1.3 Various system earthing envisaged in the power project are as follows:

S. No.	System Voltage	Neutral	Maximum earth fault current
1.	400 kV system	Solidly earthed	63 kA
2.	33 kV system	Solidly earthed	25 kA
3.	Generator	High impedance earthed	10 A
4.	11 kV system	Medium resistance earthed	300 A
5.	6.6 kV system	Medium resistance earthed	300 A
6.	415 V system	Solidly earthed	65/50 kA

The safety and equipment earthing systems should meet the following requirements:

- a) All metallic enclosures on equipment and exposed noncurrent-carrying conductive materials capable of becoming energized due to either insulation failure, inadvertent contact with an energized conductor, or building up of a static or induced voltage should be earthed.
- b) The earthing arrangement should ensure a deliberate earth fault current return path, so that the (overcurrent or earth fault) protection shall sense the fault and either trip the faulty circuit or provide an alarm to the station operator.
- c) The earthing should limit the step and touch voltage to acceptable limits during an earth fault.
- d) The earthing conductors and connections should withstand the earth fault current for the duration of the fault, without being damaged by thermal, thermo-mechanical or electromechanical stresses.
- e) The earthing conductors should be continuous; no switching device should be inserted in the earthing conductors (except where the operation of the switching device shall also automatically disconnect all power sources to the equipment earthed by that conductor). Equipment enclosures should not be used as part of the earthing conductor.
- f) The earthing conductors should be mechanically reliable or protected in order to withstand any possible mechanical stress imposed on them. The exposed connections of earthing conductors should be accessible for inspection.
- g) The earthing system should be designed to minimize corrosion to adjacent structures, equipment and enclosures.

4.1.4 The earth mat design for GIS building , switchyard and transformer yard shall be designed as per IEEE 80. The earthing system of Switchyard shall meet the following requirements:

- Ensure adequate earth fault current for operation of earth fault protection
- Limit step and touch voltages to acceptable limits during earth fault
- Earthing conductors and connections shall withstand earth fault current for the duration of the fault



- 4.1.5 The earth mat shall be designed with grid spacing such that safe voltage gradients are maintained. Earth conductors shall be installed below ground shall be spaced in a grid pattern to provide the earthing mesh grid throughout the site. Switchyard earth mat shall be interconnected with main plant earth mat by a minimum of two parallel conductors.
- 4.1.6 The mild steel earth grid shall be designed to withstand 40 years of corrosion and still retain safe touch and step potentials in accordance with IEEE 80. Corrosion rate shall be arrived at as per soil resistivity report.
- 4.1.7 The earth mat of the station shall be designed such that the total ground resistance does not exceed 0.5 ohm.
- 4.1.8 Earth mat and all earthing conductors for GIS building earthing shall be of copper. The earthing conductor material for other locations shall be corrosion resistant steel.
- 4.1.9 400 kV system earth fault current of 63 kA shall be considered for earthing design. The earthing design shall consider the following:
- Earth fault current duration for conductor sizing : 1 sec
 - Shock duration for mesh sizing : 0.5 sec
 - Depth of buried earthing conductor : minimum 600 mm
 - Human body weight for step / touch voltage calculation : 70 kg
 - Resistivity of concrete : 500 ohm m
- 4.1.10 Contractor shall carry out earth resistivity test of power project site and shall establish homogeneous soil resistivity for earthing design. Number of earth resistivity test locations shall be not less than 10. The test locations shall be subject to Owner's approval.
- 4.1.11 For Gas insulated switchyard the following aspects shall be considered:
- All metallic enclosures should normally operate at ground voltage level.
 - When grounded at the designated points, the bus enclosure design should ensure that no significant voltage differences exist between individual enclosure sections and that neither the supporting structures nor any part of the grounding systems is adversely influenced by the flow of induced currents.
 - To avoid the circulation of enclosure currents beyond regular return path within the GIS assembly, power cable sheath grounds should be tied to the grounding system via connections that are separated from the GIS enclosures. Very fast transients generated by switching or by faults in the GIS may cause these insulation elements to flashover. In such cases, the consequences of such flashovers on current distribution within the grounding system should be considered.
 - Enclosure return currents also cannot be permitted to flow through any mounted current transformers.
 - In GIS building, earth mat of copper flat shall be embedded in the concrete floor in grid / mesh form. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
- 4.1.12 The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences. The following shall be ensured.
- The grounding system shall ensure safe touch & step voltages in all the enclosures
 - All GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. shall be connected to the ground bus of GIS.
 - The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections



should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars.

- The grounding continuity between each enclosure shall be effectively interconnected with copper bonds of suitable size to bridge the flanges.
- Suitable measure shall be provided to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase/ earth fault and discharges between contacts during switching operation. Suitable barrier of non-linear resistor at SF6/ Air termination, cable bushing etc. to mitigate transient enclosure voltage shall be provided.

- 4.1.13 Earthing terminal of each lightning arrester and capacitor voltage transformer shall be directly connected to earth electrode which in turn, shall be connected to station earthing grid.
- 4.1.14 Isolation of main plant earth mat and GIS Switchyard earth mat shall be provided by test link.
- 4.1.15 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it.
- 4.1.16 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
- 4.1.17 Earthing conductor shall be buried 2000 mm outside the Switchyard fence. All the gates and every alternate post of the fence shall be connected to earthing grid.
- 4.1.18 For the power house building involving turbine hall, boiler and ESP, earthing conductor shall be buried in ground in mesh form to enable earthing of all major steel structures, electrical equipment etc.
- 4.1.19 For auxiliary plants, earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. Earth risers shall be extended to the building interior for equipment earthing.
- 4.1.20 In all the electrical rooms, earth mat (galvanized steel flat) shall be embedded in the concrete floor in grid / mesh form. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
- 4.1.21 Earth pit shall be constructed as per approved drawing. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 6000 mm. Earth pits shall be treated with salt and charcoal.
- 4.1.22 Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment / structure foundations. Earthing conductors crossing the road / rail tracks shall be laid at 600 mm depth.
- 4.1.23 All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 4.1.24 Earth pits shall be located avoiding interference with road, building foundation, column, equipment foundation etc. The disconnect facility shall be provided for individual earth pits to check their earth resistance periodically. Proper symmetry and distance between earth pits shall be maintained as per applicable standards and procedures. Treated earth pits shall conform to relevant standard.



- 4.1.25 Construction of trench for earthing conductor shall include excavation, laying of conductor, back filling and compacting. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench / foundation / underground pipes at crossings.
- 4.1.26 HV Neutral point of the following transformers shall be directly connected to earth through two numbers treated earth pit.
- Generator transformers
 - Standby transformer
 - 33 kV winding of Auxiliary transformer
- 4.1.27 LV Neutral point of the following transformers shall be directly connected to earth through two numbers treated earth pit.
- LT Service transformers
- 4.1.28 LV Neutral Points of the following transformers shall be connected to Neutral Grounding Resistors (NGRs). NGR shall be connected to earth through two numbers treated earth pit.
- Unit transformer
 - Station Transformer
 - Unit auxiliary transformer
 - Station auxiliary transformer
 - Other auxiliary transformers
- 4.1.29 Earth pits/earth electrodes shall be interconnected to near by station earthing grid.
- 4.1.30 For equipment earthing, earthing conductor shall be sized to withstand earth fault current of the system for the duration permissible by the protection device. Thickness of galvanising shall be atleast 610 gm/sq.m for all steel conductors.
- 4.1.31 Size of the earthing conductor shall be not less than the following:

Sl. No.	Equipment	Size/ type of Earthing material
1)	Main earthing conductor / Earth mat	40 mm dia corrosion resistant steel rod
2)	Earth risers from earth mat	40 mm dia corrosion resistant steel rod or 65X8 mm size GS flat
3)	Rod earth electrode	40 mm dia corrosion resistant steel rod
4)	Earth conductor embedded in concrete in GIS building	Copper flat
5)	Earth conductor embedded in concrete	50X6 mm GS flat
6)	Treated earth pit for power circuit	Minimum 65 mm dia galvanized steel pipe electrode as per IS:3043
7)	Electronic earthing	Chemical earth pit with copper electrode
8)	EHV Equipment	
	a) Equipment earth pad to structure, Structure to earth mat	2 nos. 75X8 mm galvanized steel (GS) flat
	b) Control cubicle, Mechanism box	2 Nos. 50X6 mm GS flat



Sl. No.	Equipment	Size/ type of Earthing material
	c) Lightning arrester Insulating base to surge counter	50 mm ² copper cable
	d) Lightning arrester Surge counter to earth (without touching structure)	75X8 mm GS flat
	e) CVT neutral to earth electrode	75X8 mm GS flat
	f) Earth switch rod to isolator frame	2 nos. copper flexible
9)	Switchyard Towers	
	a) Tower peak to test link	7/3.66 mm galvanized steel shield wire
	b) Test link to main earth mat	50X6 mm GS flat
	c) Structure to earth mat	75X8 mm GS flat
10)	HT transformers (enclosure and neutral)	65X8 mm GS flat
11)	LT transformers (enclosure and neutral)	75X8 mm GS flat
12)	DG set (enclosure and neutral)	50X6 mm GS flat
13)	Generator, LAPT, NGT, NGT neutral	50X6 mm GS flat
14)	HT Switchgear, HT motors, HT busducts	50X6 mm GS flat
15)	LT Switchgear (PCC & MCC), LT busduct	75X8 mm GS flat
16)	All distribution boards	50X6 mm GS flat
17)	LT motors of 75 kW and above	50X6 mm GS flat
18)	LT motors of 30 kW to <75 kW	32X5mm GS flat
19)	LT motors of 9.3 kW to <30 kW	25X3mm GS flat
20)	LT motors of 5.5, 7.5 kW	4 SWG GS wire
21)	LT motors of <5 kW	6 SWG GS wire
22)	Charger / UPS	50X6 mm GS flat
23)	Lighting panels	25X6 mm GS flat
24)	Relay panels / SAS panel	25X6 mm copper flat
25)	Cable trays	50X6 mm GS flat
26)	CT junction box / PT junction box	50X6 mm GS flat
27)	Lighting / Control junction boxes	14 SWG GS wire
28)	Lighting poles/masts	20 mm dia, mild steel earth electrode
29)	Local push button stations	8 SWG GS wire

4.1.32 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Steel columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing.

4.1.33 Metallic conduits shall not be used as earth continuity conductor.



- 4.1.34 Flexible earthing connectors shall be provided for moving parts.
- 4.1.35 50 mm x 6 mm galvanized steel flat shall run all along the cable tray routes and the same shall be welded / connected to each of the tray /rack. Further, this flat shall be earthed at both ends and at an interval of 30 m.
- 4.1.36 Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making earth connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint / compound.
- 4.1.37 Connection between earthing conductors shall be welded type. For rust protection, the welds shall be treated with red lead and coated with two layers bitumen compound.
- 4.1.38 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- 4.1.39 Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- 4.1.40 Earthing conductors along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 1000 mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- 4.1.41 Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- 4.1.42 Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.
- 4.1.43 For electronic equipment such as DCS, Respective control system, SAS, EMS etc., chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 4000 mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be of copper.
- 4.1.44 **Earthing of chimney:** Earthing shall be carried out by routing 50x6 mm galvanised steel strip earthing conductor from chimney top up to ground. Each earthing conductor shall be earthed by using 40 mm dia 4 metre mild steel rod and shall also be interconnected with the power station earthing grid.
- 4.1.45 Earthing of cabling system
- Armour of the HT cables and LT single core cables shall be earthed only at one end of cable.
 - Armour of other cables shall be earthed at both ends of cable.
 - Screen of HT power cables shall be earthed at one end only.
 - Screen of C&I screened control cables shall be earthed at one end.
 - Screen of electronic earthing system cables shall be earthed as per the requirements.
- 4.1.46 After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. continuity of earth conductors and efficiency of all bonds and joints shall be checked. Before measurement, the overhead ground wires shall be disconnected from the GIS Switchyard. The method of measurement shall be as per relevant standards / codes. The ground resistance of GIS Switchyard grounding system shall be not more than 0.5



ohm. Earth resistance at earth terminations shall be measured in presence of Owner's representatives

5.0.0 LIGHTNING PROTECTION SYSTEM

- 5.1.0 Direct stroke lightning protection (DSLPP) shall be provided in the GIS Switchyard by lightning masts and shield wires including connections, earth pits etc. to make the lightning protection complete for the outdoor GIS Switchyard including reactors. The arrangement shall be based on DSLPP calculations. Contractor shall furnish necessary design calculation for approval by Owner.
- 5.2.0 The lightning protection system in the transformer yard shall cover the following equipment in the protection zone.
- Generator transformers
 - Station transformers
 - Standby transformers
 - Auxiliary transformers
- 5.2.0 All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of air termination network, down conductors, test link and earth electrodes.
- 5.3.0 Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- 5.4.0 For Lightning protection, material & sizes shall be as follows:
- Vertical air termination : 20 mm dia galvanised steel rod
 - Horizontal air termination : 25X6 mm Galvanised steel Strip
 - Down conductor : 25X6 mm Galvanised steel Strip
 - Test link : 150x50x6 mm Galvanised steel Strip with Box
 - Earth Electrodes : Treated earth pit with rod electrode as per IS:3043
- 5.5.0 Thickness of galvanising shall be atleast 610 gm/sq.m for all galvanised steel conductors.
- 5.6.0 The lightning protection system shall not come in direct contact with other equipment/systems such as cables, conduits, electrical equipment, underground metallic ducts etc. All metallic structures within vicinity shall be bonded to the lightning protection system.
- 5.7.0 All welded/brazed joints shall be coated with anti- corrosive paint for rust protection.
- 5.8.0 Lightning conductor when used above ground level and shall be connected through test link with earth electrode/earthing system. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- 5.9.0 Each down conductor shall be provided with a test link at 1500 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be of welded type.
- 5.10.0 Down conductors shall be cleated on outer side of building wall/ welded to outside building columns at 750 mm interval.



- 5.11.0 Lightning conductor on roof shall be cleated on surface of roof using insulated clamps/saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run..
- 5.12.0 Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- 5.13.0 Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

5.14.0 Lightning protection system for chimney

- 5.14.1 The lightning protection system for chimney shall be installed in accordance with IS 2309. Pointed vertical air terminal rods shall be provided at the top and these shall be equally spaced at 120 degree around the circumference of the top flue cane. Air terminals shall project not less than 1000 mm above the highest part of the flue cane. Air terminals shall be mechanically and electrically connected to a continuous circumferential conductor.

- 5.15.0 For Lightning protection, material & sizes shall be as follows:

- Vertical air termination : 20 mm dia lead coated steel rod
- Horizontal air termination (top 12 metre): 25X3 mm lead coated copper strip
- Horizontal air termination (remaining portion): 50X6 mm Galvanised steel Strip
- Down conductor (top 12 metre) : 25X3 mm lead coated copper strip
- Down conductor (remaining portion) : 50X6 mm Galvanised steel Strip
- Coronal band (top) : 70 sq.mm lead coated copper conductor
- Coronal band (mid-height) : 70 sq.mm copper conductor
- Test link : 150x50x6 mm Galvanised steel flat in steel enclosure
- Earth Electrodes : Treated earth pit with rod electrode as per IS:3043

- 5.14.2 Two cable collars, , shall encircle the chimney; one at the top, interconnecting the lower ends of the air terminals and the down conductors, and one approximately mid-height of the chimney, connecting the down conductors. Not less than four down conductors along shell shall be located along the exterior wall of the shell, shall extend to the chimney base to earth electrode pit, and shall be connected to the plant grounding grid.

- 5.14.3 Air terminals, connections, conductors, clamps, fixtures, anchors, etc., exposed within 12000 mm of the top of the chimney shall have a continuous lead covering of a sheath of commercially pure lead not less than 2 mm in thickness.

- 5.14.4 During construction, temporary lightning protection should be maintained by connecting the concrete reinforcement to two permanent electrical grounding conductors. After the top lift of the chimney shell has been completed, temporary air terminals which may consist of reinforcing bars, should be installed at the top to serve as a temporary protection until the lining and cap are completed and permanent air terminals are installed.

5.16.0 Lightning Protection System for cooling tower and Ash Silo

- 5.15.1 Pointed vertical air terminal rods shall be provided at the top and these shall be spaced around the circumference of the top. Air terminals shall consist of galvanized steel conductors, each not less than 20 mm diameter galvanized steel rod, projecting not less than 1000 mm above the highest part structure. Air terminals shall be mechanically and electrically connected to a continuous circumferential conductor. Number of down conductors as per IS: 2309, shall be located along the exterior wall, shall extend to the base to earth electrode pit, and shall be connected to the power station earth grid.



5.17.0 For Lightning protection, material & sizes shall be as follows:

- Vertical air termination : 20 mm dia lead coated steel rod
- Horizontal air termination : 50X6 mm Galvanised steel Strip
- Down conductor : 50X6 mm Galvanised steel Strip
- Coronal band (at top)) : 70 sq.mm copper conductor
- Test link : 150x50x6 mm Galvanised steel flat in steel enclosure
- Earth Electrodes : Treated earth pit with rod electrode as per IS:3043

5.15.2 During construction, temporary lightning protection should be maintained by connecting the concrete reinforcement to two permanent electrical grounding conductors.

5.16.0 On completion of lightning installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Owner. Resistance of individual earth electrode shall be measured after disconnecting it from the grid. Tests shall be carried out as per IS : 3043 for earthing installation including the following:

- a) Earth continuity checks
- b) Earth resistance of the complete system, sub-system and earth pits

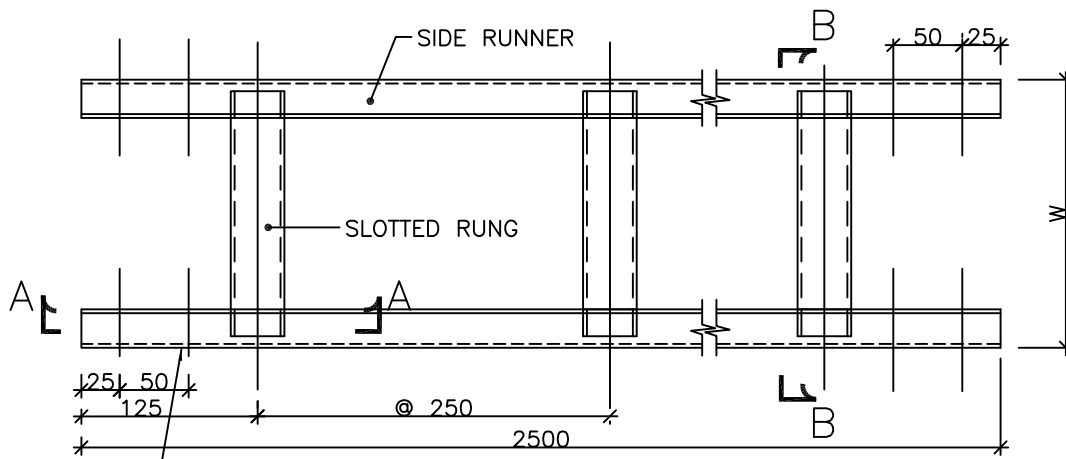
6.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

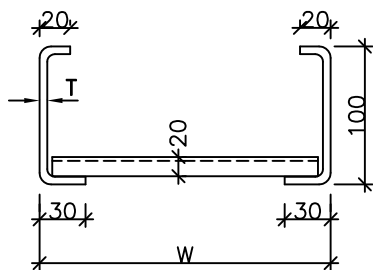
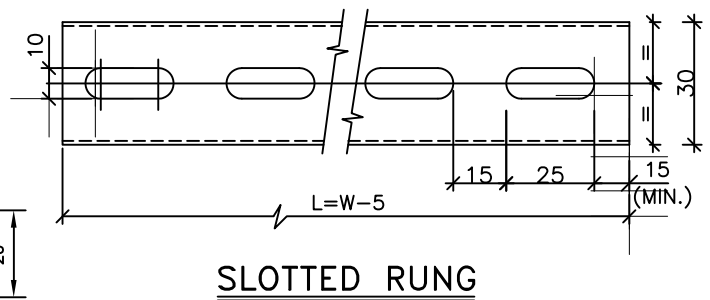
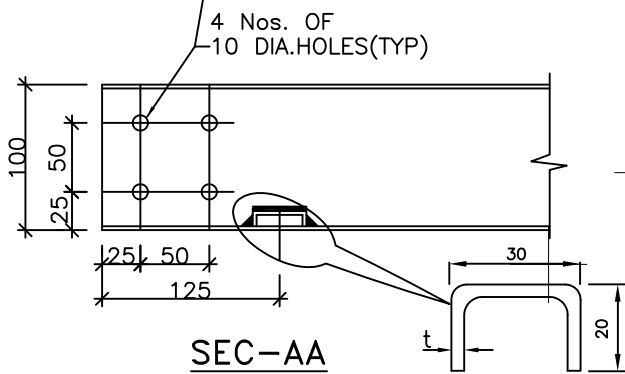
- Soil resistivity report
- Design basis report for earthing and lightning protection system
- Earthing design calculation
- Typical installation drawings for earthing and lightning protection
- Electronic earthing layout and details
- Earthing layout for Transformer Yard
- Earthing layout for Power house building, Boiler and ESP
- Earthing layout for Chimney
- Earthing layout for Cooling tower
- Earthing layout for all auxiliary plant buildings
- Earthing layout for all non-plant buildings
- Earthing layout for GIS building and Switchyard
- Lightning protection design calculation
- Lightning protection layout for Power house building, Boiler and ESP
- Lightning protection layout for transformer yard
- Lightning protection layout for all auxiliary plant buildings
- Lightning protection layout for all non-plant buildings
- Lightning protection layout for GIS building and Switchyard
- Lightning protection layout for Chimney
- Lightning protection layout for Cooling tower
- Field quality plan

TYPICAL DETAILS OF
CABLE TRAYS AND ACCESSORIES
(GS AND FRP TYPE)

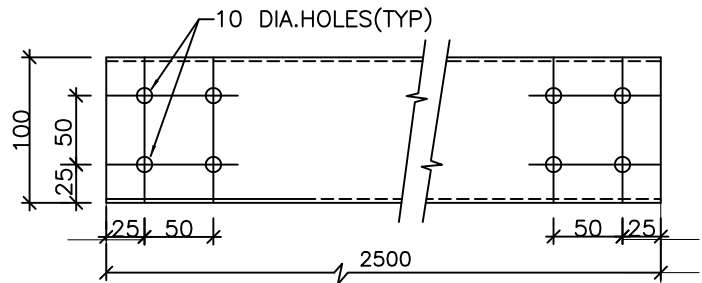
CUSTOMER	TAMIL NADU GENERATION & DISTRIBUTION CORPORATION LIMITED						
PROJECT	2 X 660 MW UDANGUDI STPP STAGE-I						
JOB NO. 435	बोयर्स एम  BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA	DPT CODE-E	DRN	NAME	SIGN	DATE	
			DSN	SKS			
			CHD	VY			
			APP	SL			
			DWG. NO.	PE-DG-435-507-E005			
		SHT. 01 OF 26					REV. 0



LADDER TYPE CABLE TRAY



SEC-BB



SIDE RUNNER

W	150	300	450	600
L	145	295	445	595
T	2	2	2	2
t	2	2	2	2

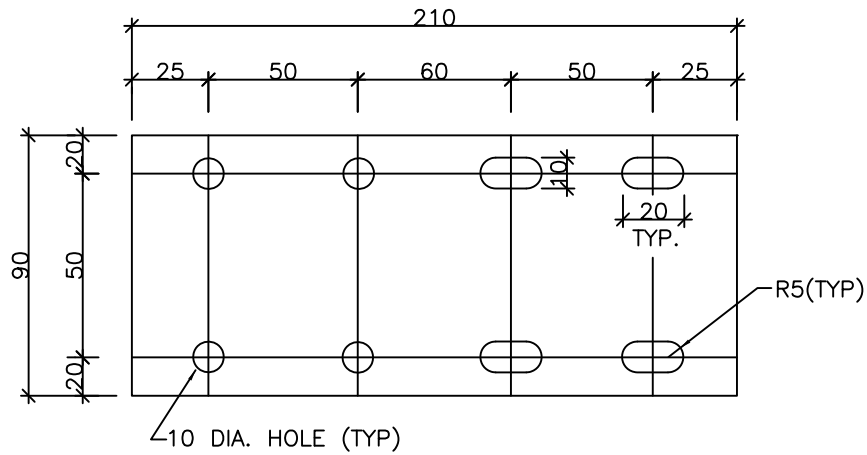
FOR GENERAL NOTES REFER SHEET 13 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (GS TYPE)

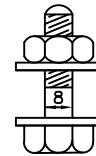
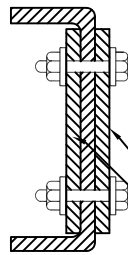
DWG. NO.
PE-DG-435-507-E005

SHT. 02 OF 26 REV. 0



**SIDE COUPLER PLATE FOR
LADDER/PERFORATED TYPE TRAYS**
(600/450/300/150W TRAYS)

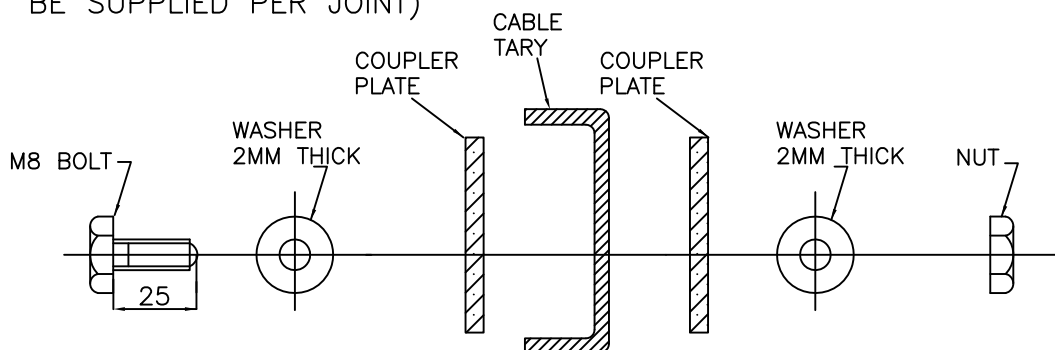
QTY. REQUIRED/TRAY SECTION : 4 NOS.



QTY. REQD/TRAY SECTION

- A) 16 NOS. M8 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS

(2 NOS. COUPLER PLATES
OF 2 MM THICKNESS TO
BE SUPPLIED PER JOINT)



**SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY
FOR TYPICAL CABLE TRAY JOINT**

FOR GENERAL NOTES REFER SHEET 13 OF 26

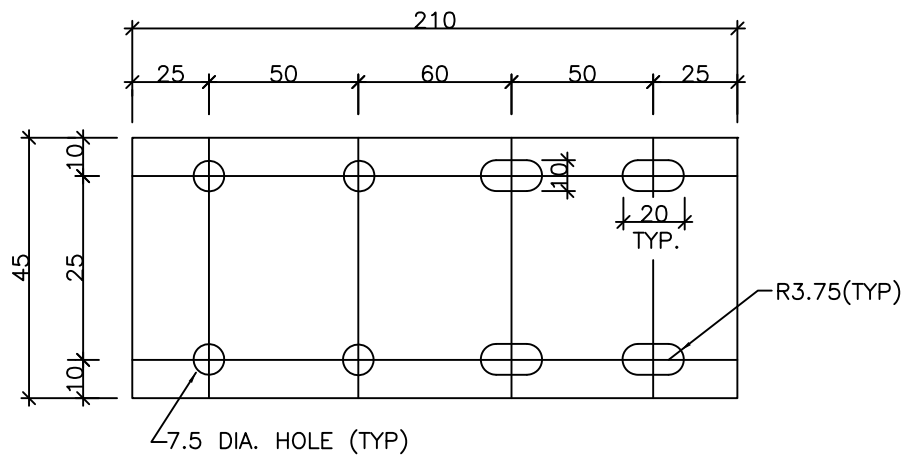


**TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)**

DWG. NO.
PE-DG-435-507-E005

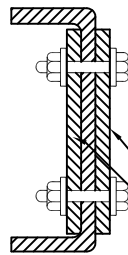
SHT. 03 OF 26

REV. 0

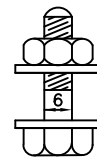


**SIDE COUPLER PLATE FOR
PERFORATED TYPE TRAYS**
(100/50W TRAYS)

QTY. REQUIRED/TRAY SECTION : 4 NOS.

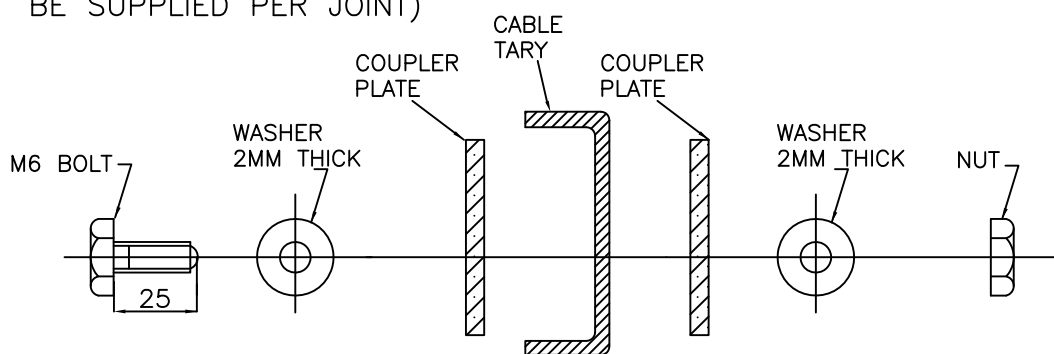


(2 NOS. COUPLER PLATES
OF 2 MM THICKNESS TO
BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

- A) 16 NOS. M6 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS



SEQUENCE OF M6 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY
FOR TYPICAL CABLE TRAY JOINT

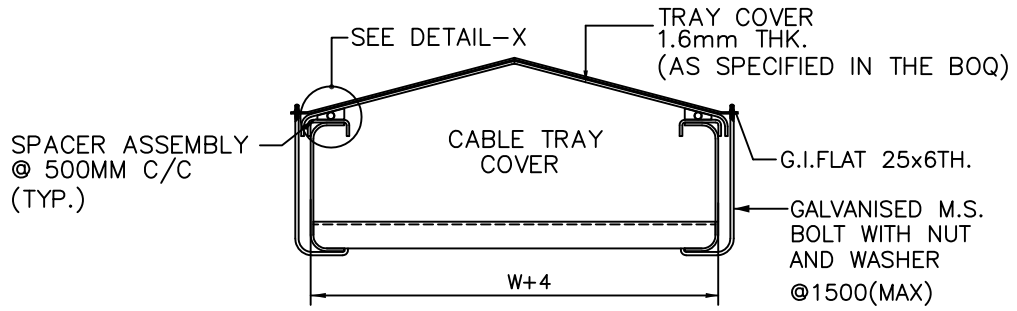
FOR GENERAL NOTES REFER SHEET 13 OF 26



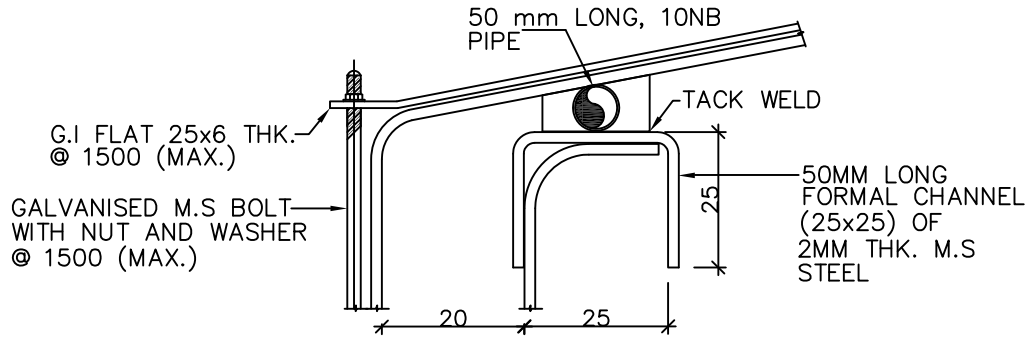
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

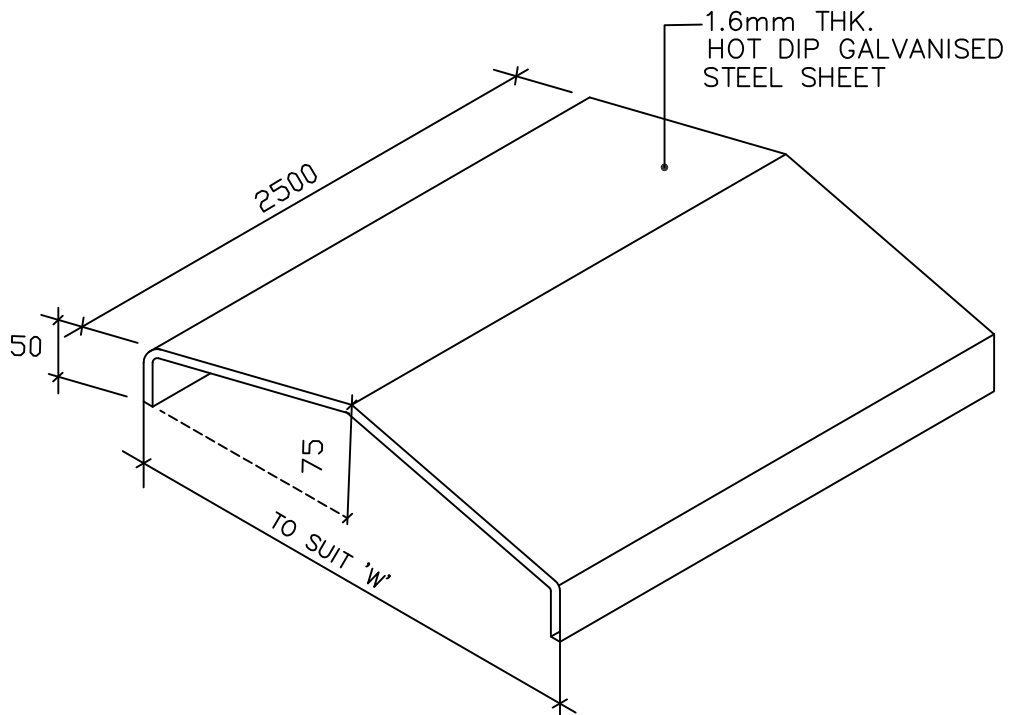
SHT. 04 OF 26 REV. 0



COVER FIXING (TYP.)



DETAIL-X



CABLE TRAY COVER

FOR GENERAL NOTES REFER SHEET 13 OF 26

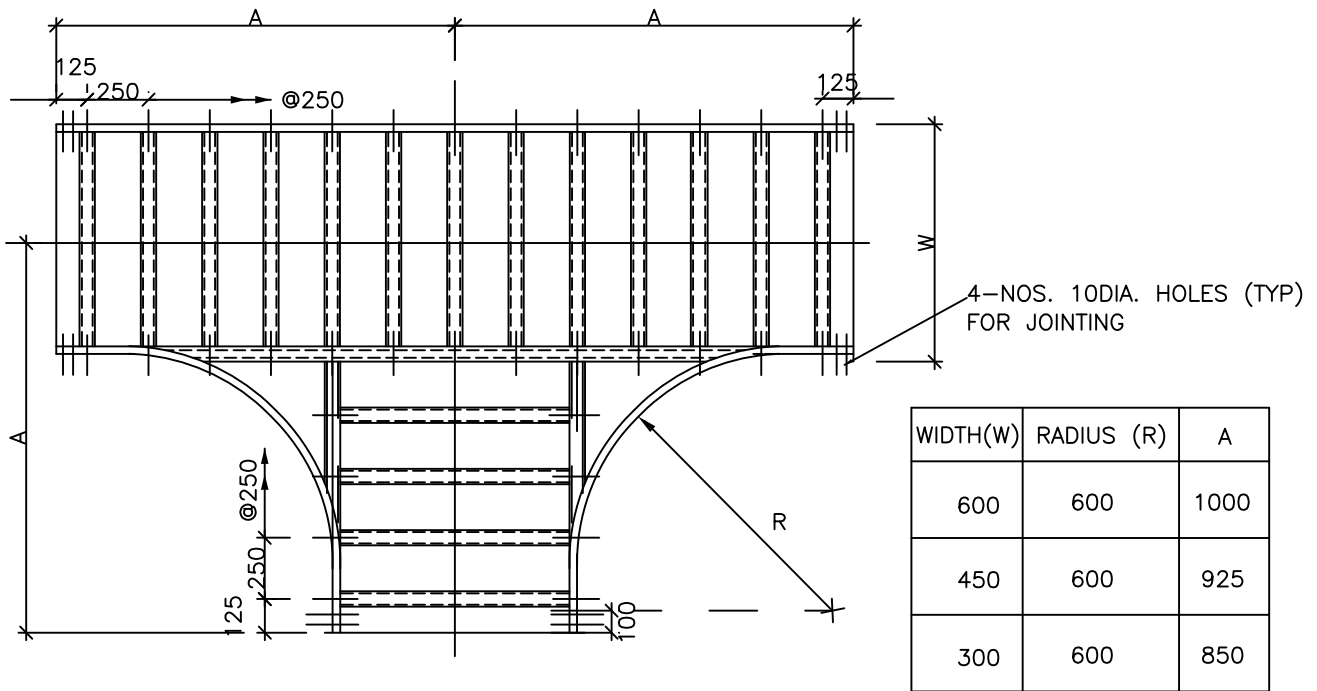


TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (GS TYPE)

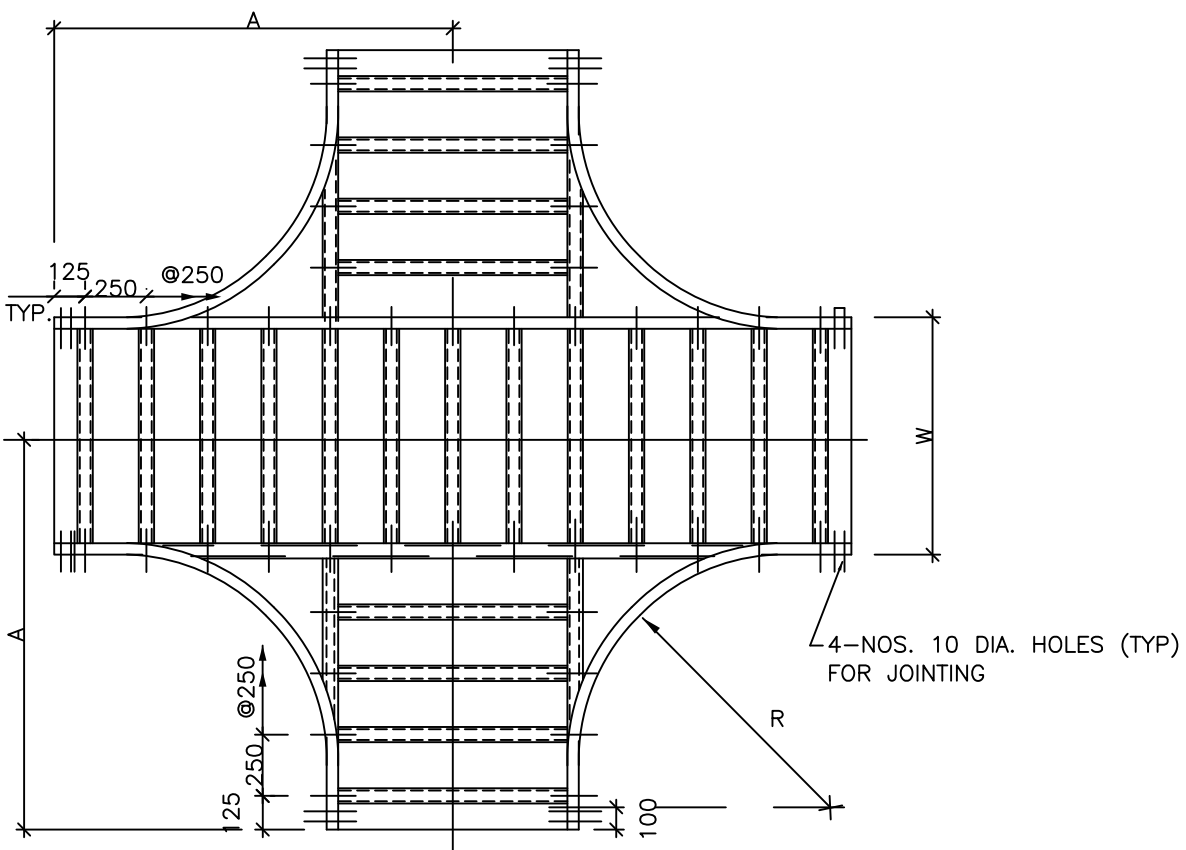
DWG. NO.
PE-DG-435-507-E005

SHT. 05 OF 26

REV. 0



HORIZONTAL TEE-PLAN



HORIZONTAL CROSS-PLAN

LADDER TYPE ACCESSORIES

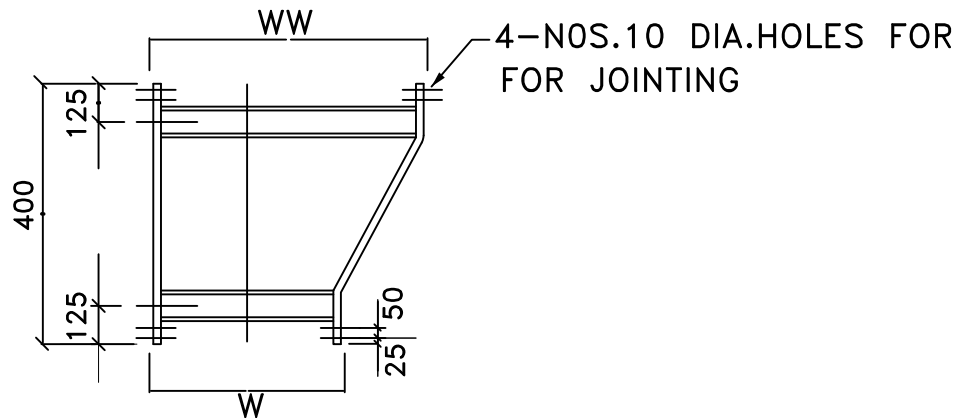
FOR GENERAL NOTES REFER SHEET 13 OF 26



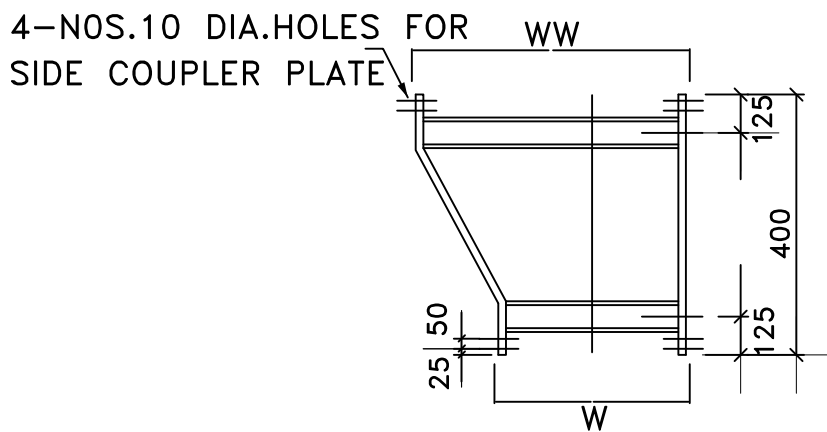
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 06 OF 26 REV. 0



LEFT HAND REDUCER-PLAN



RIGHT HAND REDUCER-PLAN

WIDTH	WW	600	600	450
	W	450	300	300

LADDER TYPE ACCESSORIES

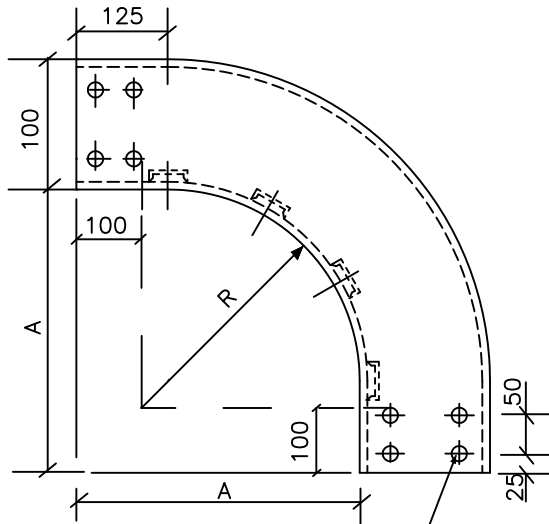
FOR GENERAL NOTES REFER SHEET 13 OF 26



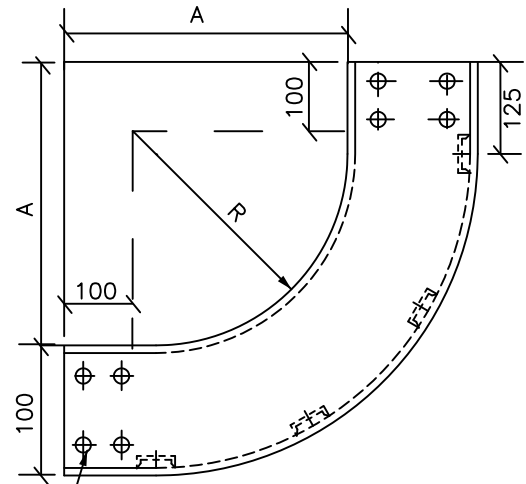
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 07 OF 26 REV. 0



ELEVATION
90° VERTICAL BEND
(OUTSIDE)

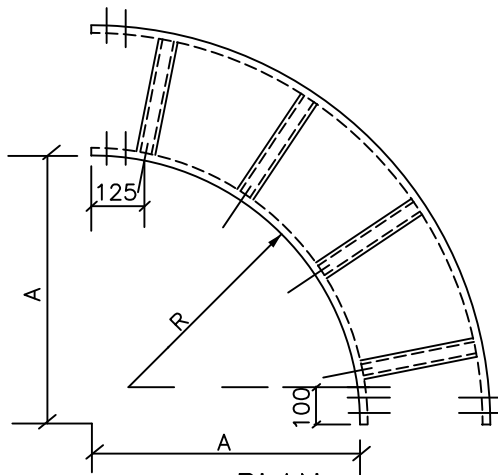


ELEVATION
90° VERTICAL BEND
(INSIDE)

4 NOS. 10 DIA. HOLES
FOR JOINTING

LADDER TYPE TRAYS

WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700



PLAN
90° HORIZONTAL BEND

LADDER TYPE ACCESSORIES

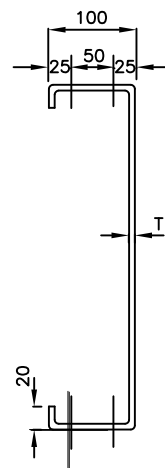
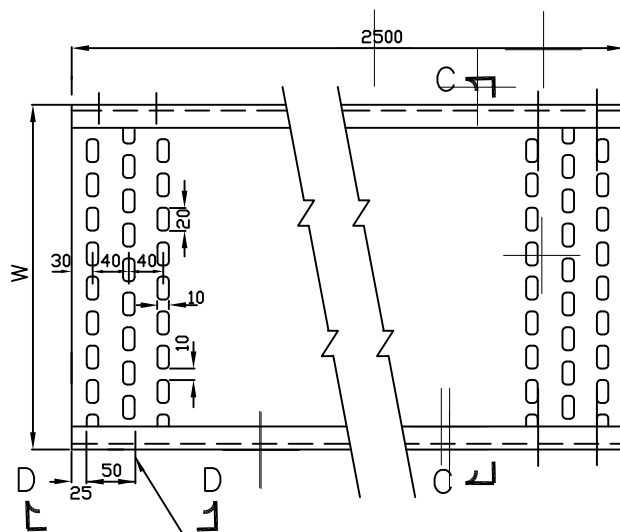
FOR GENERAL NOTES REFER SHEET 13 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

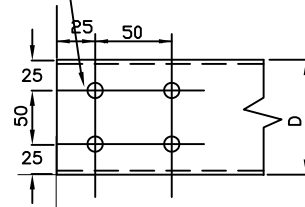
DWG. NO.
PE-DG-435-507-E005

SHT. 08 OF 26 REV. 0



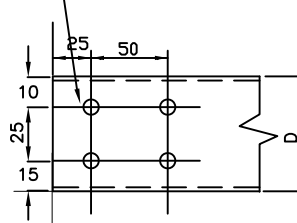
SECTION-CC
(600/450/300/150 TRAYS)

4 HOLES 10mm DIA.

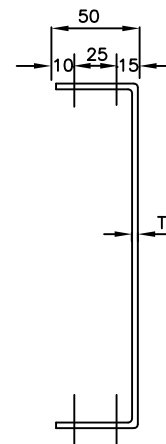


VIEW-DD
(600/450/300/
150W TRAYS)

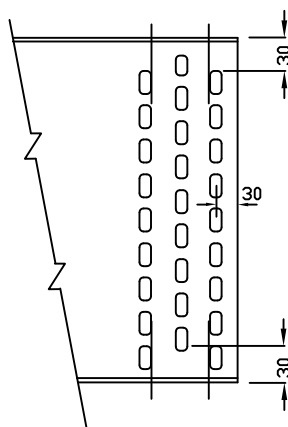
4 HOLES 7.5mm DIA.



VIEW-DD
(100/50W TRAYS)



SECTION-CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

TRAY WIDTH W (mm)	600	450	300	150	100	50
TRAY DEPTH D (mm)	100	100	100	100	50	50
T (mm)	2	2	2	2	2	2

PERFORATED TYPE TRAY

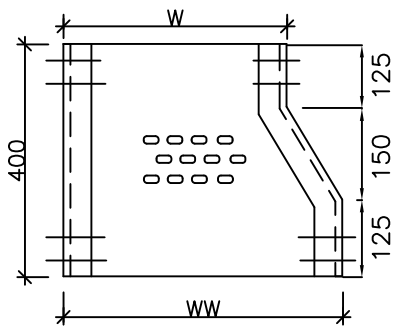
FOR GENERAL NOTES REFER SHEET 13 OF 26



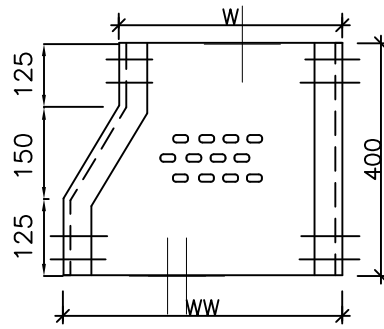
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 09 OF 26 REV. 0



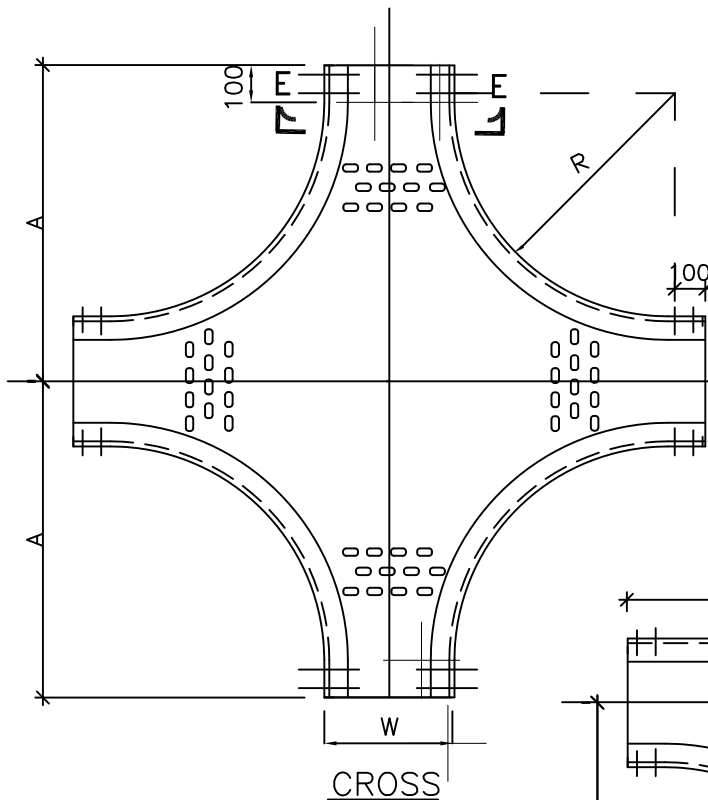
LEFT HAND REDUCER



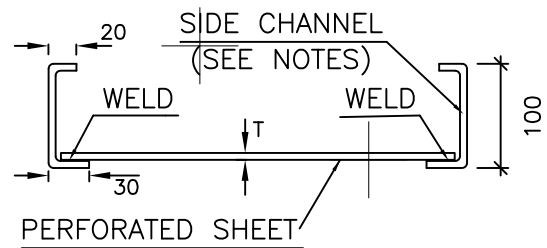
RIGHT HAND REDUCER

WW	W	DEPTH	THICKNESS
600	450	100	2
600	300	100	2
450	300	100	2

PERFORATED TYPE



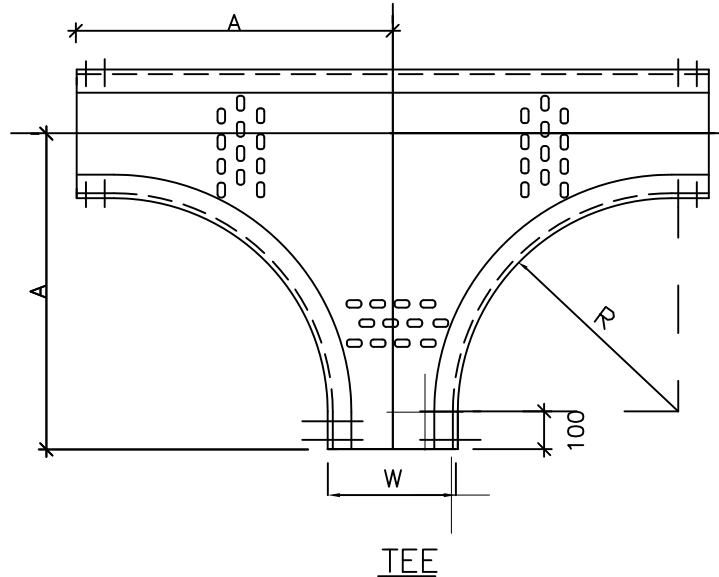
CROSS



SECTION-EE

PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	1000	2
450	600	925	2
300	600	850	2



TEE

PERFORATED TYPE ACCESSORIES

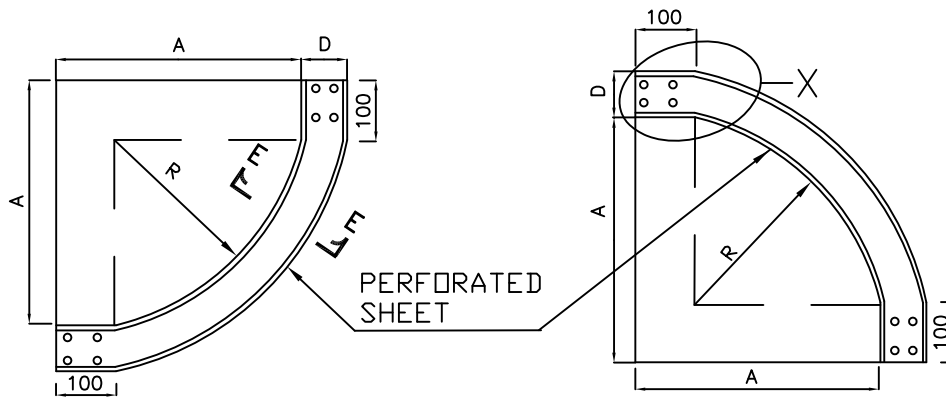
FOR GENERAL NOTES REFER SHEET 13 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

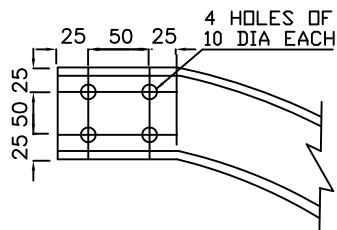
DWG. NO.
PE-DG-435-507-E005

SHT. 10 OF 26 REV. 0

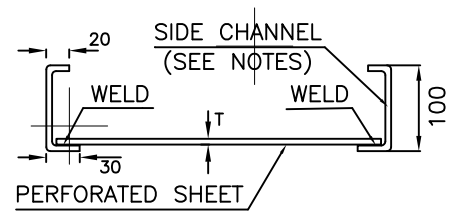


INSIDE TYPE

OUTSIDE TYPE

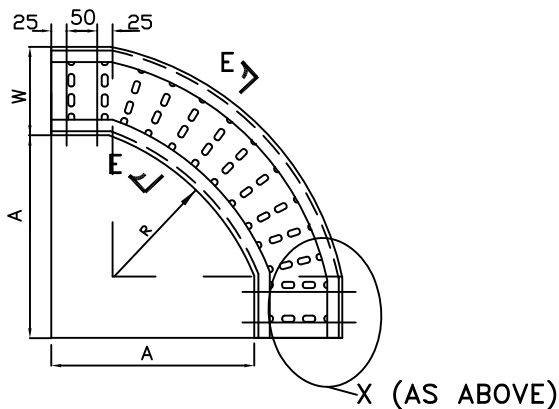


ENLARGED VIEW OF "X"



SECTION-EE

90° VERTICAL BEND - PERFORATED TYPE



90° HORIZONTAL BEND - PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	700	2
450	600	700	2
300	600	700	2

PERFORATED TYPE ACCESSORIES

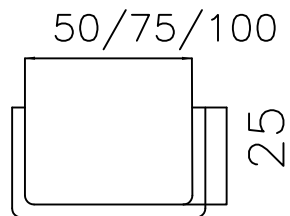
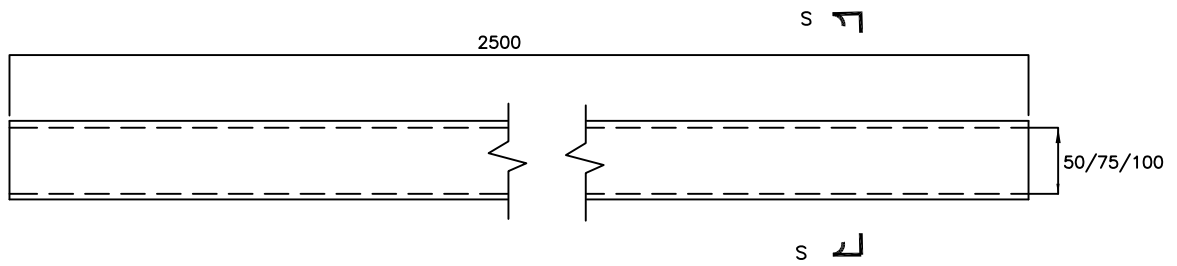
FOR GENERAL NOTES REFER SHEET 13 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 11 OF 26 REV. 0



SECTION-SS

CABLE TROUGH

FOR GENERAL NOTES REFER SHEET 13 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (GS TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 12 OF 26 REV. 0

NOTES:-

1. THE LADDER AND PERFORATED TYPE CABLE TRAYS AND ACCESSORIES (INCLUDING SIDE RUNNERS OF LADDER TYPE TRAYS & ACCESSORIES) SHALL BE MADE OF 2MM HOT ROLLED M.S. SHEET. ALL THE COUPLER PLATE SHALL BE 2 MM THICK.
2. THE CABLE TRAYS & ACCESSORIES SHALL BE HOT DIP GALVANISED AS PER IS 2629. THE MASS OF ZINC COATING SHALL BE 610 gm/m² AND THICKNESS SHALL BE 86 MICRONS (MINIMUM).
3. FOR LADDER TYPE CABLE TRAYS AND ACCESSORIES, ALL RUNGS SHALL BE SLOTTED. PERFORATED TRAYS SHALL BE FABRICATED OUT OF A SINGLE M.S. SHEET.
4. STANDARD TRAY ACCESSORIES SHALL BE WITH THE RADIUS INDICATED IN THIS DRAWING.
5. SIDE CHANNELS OF PERFORATED TYPE CABLE TRAY ACCESSORIES SHALL BE WELDED WITH THE PERFORATED SHEET AT INTERVALS OF 100mm.
6. LENGTH OF WELDING SHALL NOT BE LESS THAN 25mm FOR CABLE TRAYS. THE THICKNESS OF WELDING SHALL BE AS PER IS 9595.
7. ALL TRAY CORNERS SHALL BE SMOOTH AND FREE OF SHARP EDGES.
8. THE CABLE TRAY COVER SHALL BE OF 1.6MM THICK MS SHEET AND SHALL BE HOT DIP GALVANISED.
9. THE DEPTH, WIDTH AND LENGTH OF TRAYS & TRAY COVERS SHALL BE WITHIN A TOLERANCE OF (+/-) 2 mm.
10. THE THICKNESS OF THE FINISHED PRODUCT CABLE TRAYS & ACCESSORIES SHALL NOT BE LESS THAN 2MM.
11. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
12. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE HOT DIP GALVANISED AS PER IS:1367 PART XIII FOR SIZES 12 MM & ABOVE, AND ELECTROPLATED/ZINC PASSIVATED FOR SIZES UPTO 12 MM.
13. ALL CUTTING & FORMING OPERATIONS SHALL BE COMPLETED PRIOR TO GALVENIZING.
14. FINISHED TRAYS SHALL BE FREE FROM BURRS AND SHARP EDGES.
15. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
16. WIDTH OF CABLE TRAYS PROPOSED TO BE USED FOR THE PROJECT ARE AS UNDER:
A) LADDER TYPE: 600W, 450W, 300W, 150W.
B) PERFORATED TYPE: 600W, 450W, 300W, 150W, 100W, 50W.
17. THE DEPTH OF 600W, 450W, 300W, 150W TRAYS & ACCESSORIES SHALL BE 100MM. DEPTH OF 100/50W TRAYS SHALL BE 50MM.
18. 600MM WIDE TYPE CABLE TRAYS SHALL BE SUITABLE FOR A CABLE WEIGHT OF 100 Kg PER METRE (INCLUDING LIVE LOAD) OF RUNNING LENGTH OF TRAY.
19. CABLE TROUGHS OR 50/100MM WIDE PERFORATED TYPE TRAY SHALL BE USED FOR LOCAL CABLING/BRANCHING OUT FEW CABLES FROM MAIN ROUTE.



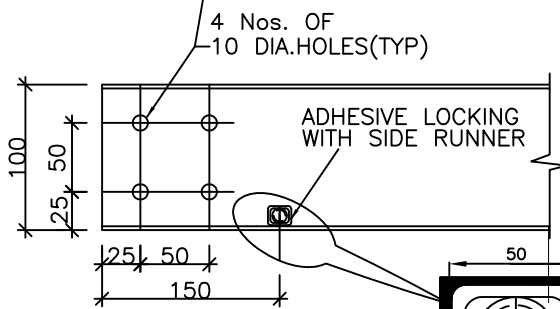
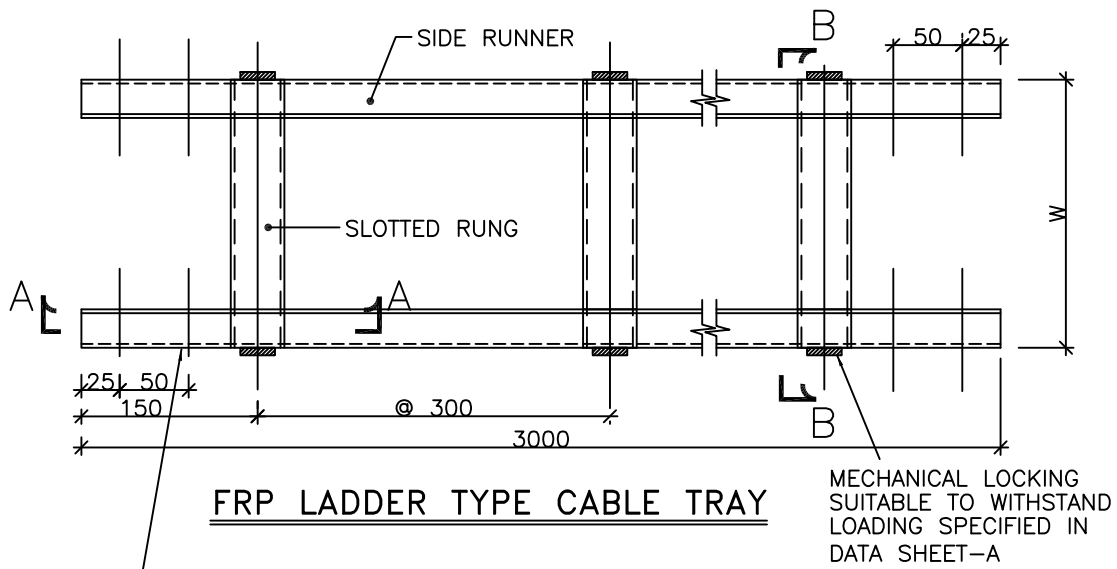
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DWG. NO.
PE-DG-435-507-E005

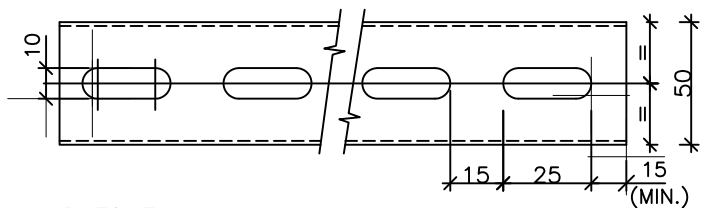
SHT. 13 OF 26 REV. 0

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

CUSTOMER	TAMIL NADU GENERATION & DISTRIBUTION CORPORATION LIMITED						
PROJECT	2 X 660 MW UDANGUDI STPP STAGE-I						
JOB NO. 435	भारत भारत भारत  BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA	DPT CODE-E	DRN	NAME	SIGN	DATE	
			DSN	SKS			
			CHD	VY			
			APP	SL			
		DWG. NO.	PE-DG-435-507-E005				
		SHT. 14 OF 26 REV. 0					

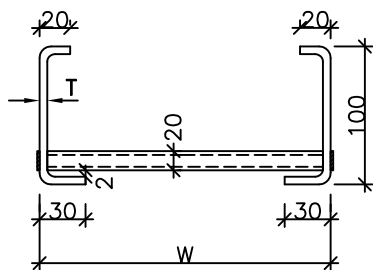


SEC-AA

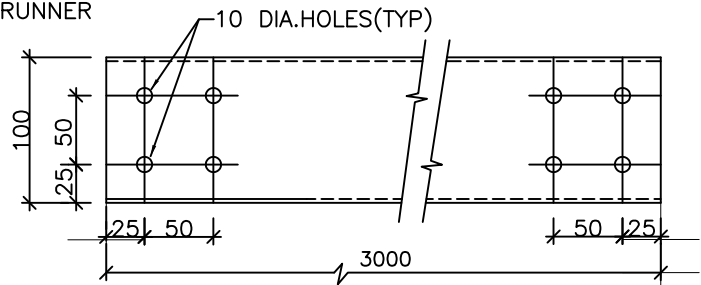


SLOTTED RUNG

MECHANICAL LOCKING OF SLOTTED RUNG HOLLOW TUBE WITH SIDE RUNNER



SEC-BB



SIDE RUNNER

W	150	300	450	600
T	4	4	4	4
t	4	4	4	4

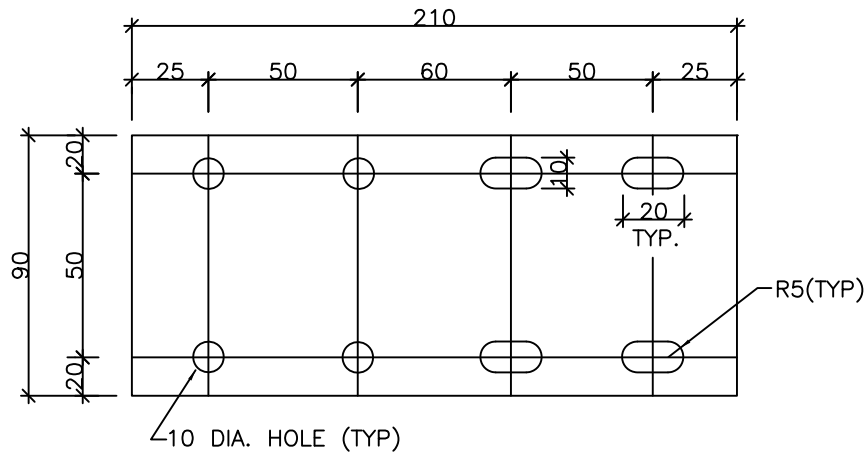
FOR GENERAL NOTES REFER SHEET 26 OF 26



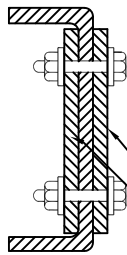
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

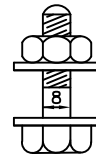
SHT. 15 OF 26 REV. 0



**FRP SIDE COUPLER PLATE FOR
FRP LADDER/PERFORATED TYPE TRAYS**
(600/450/300/150W TRAYS)
QTY. REQUIRED/TRAY SECTION : 4 NOS.

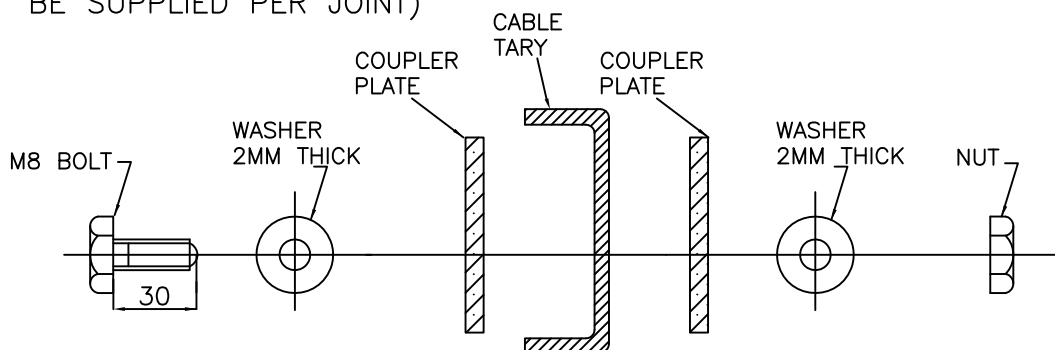


(2 NOS. COUPLER PLATES
OF 2 MM THICKNESS TO
BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

- A) 16 NOS. M8 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS



SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY
FOR TYPICAL CABLE TRAY JOINT

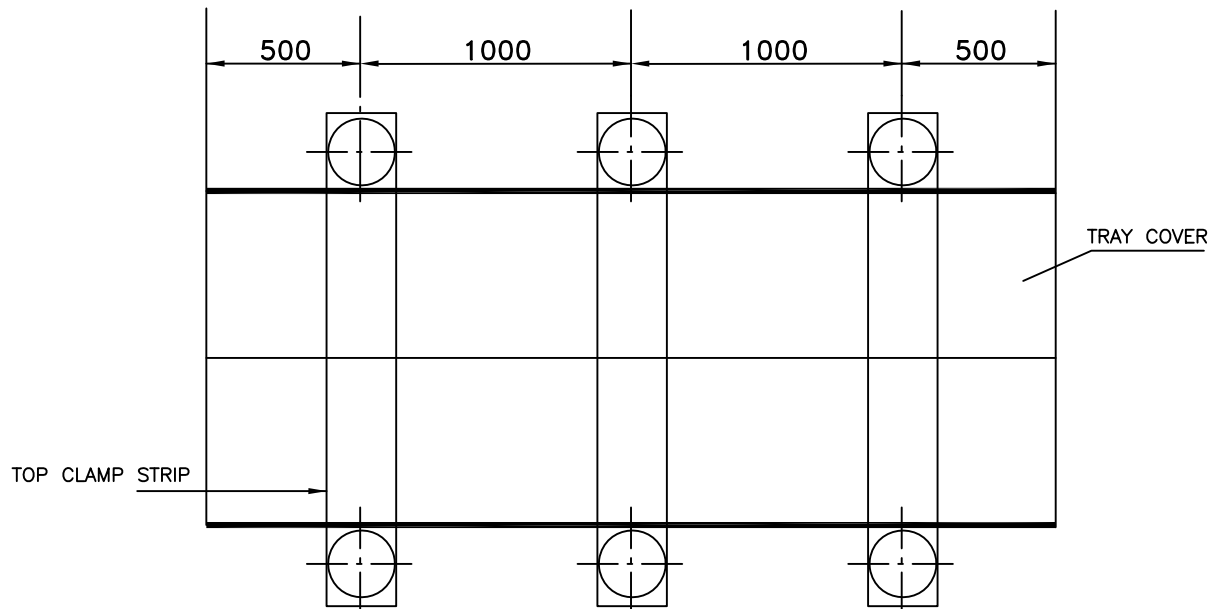
FOR GENERAL NOTES REFER SHEET 26 OF 26



**TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (FRP TYPE)**

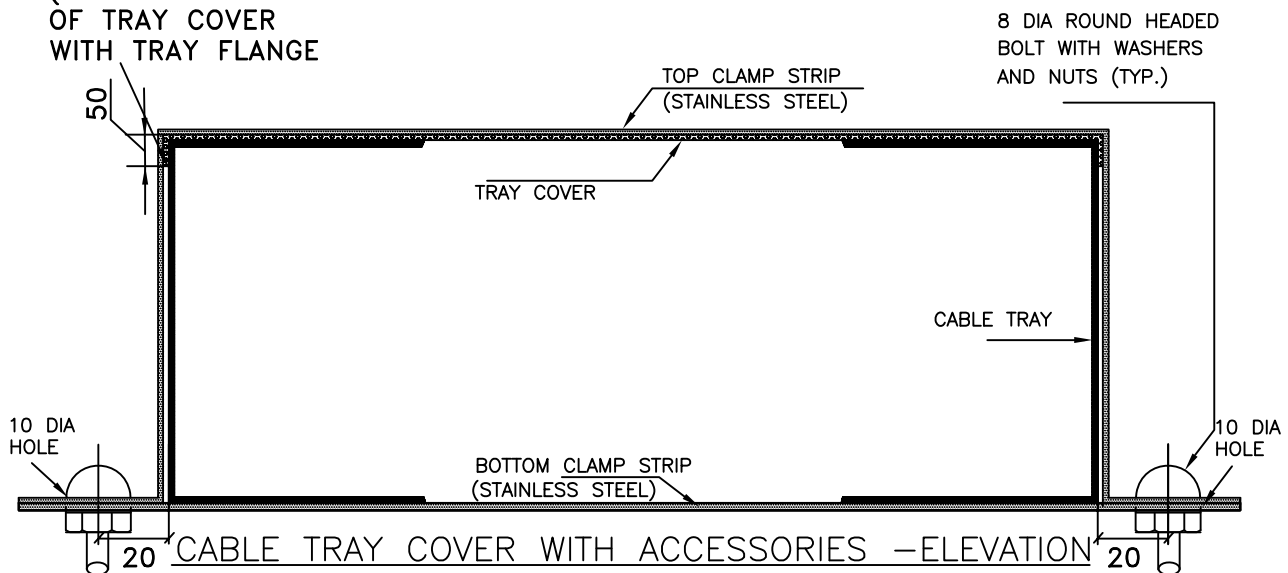
DWG. NO.
PE-DG-435-507-E005

SHT. 16 OF 26 REV. 0



CABLE TRAY COVER WITH ACCESSORIES –PLAN

(OVER LAP PORTION
OF TRAY COVER
WITH TRAY FLANGE



CABLE TRAY COVER WITH ACCESSORIES –ELEVATION

TRAY WIDTH(W)	TOP CLAMP SIZE (LxWxT)	BOTTOM CLAMP SIZE (LxWxT)
600	900X20X2	680X20X2
450	750X20X2	530X20X2
300	600X20X2	380X20X2
150	450X20X2	230X20X2

CABLE TRAY COVER SHALL INCLUDE 1 NO. OF TRAY COVER OF 3000MM LENGTH ALONG WITH 3 NOS. OF TOP CLAMP STRIP, 3 NOS. BOTTOM CLAMP STRIP AND 6 NOS. OF BOLTS ALONG WITH NUTS & WASHERS.

CABLE TRAY COVER

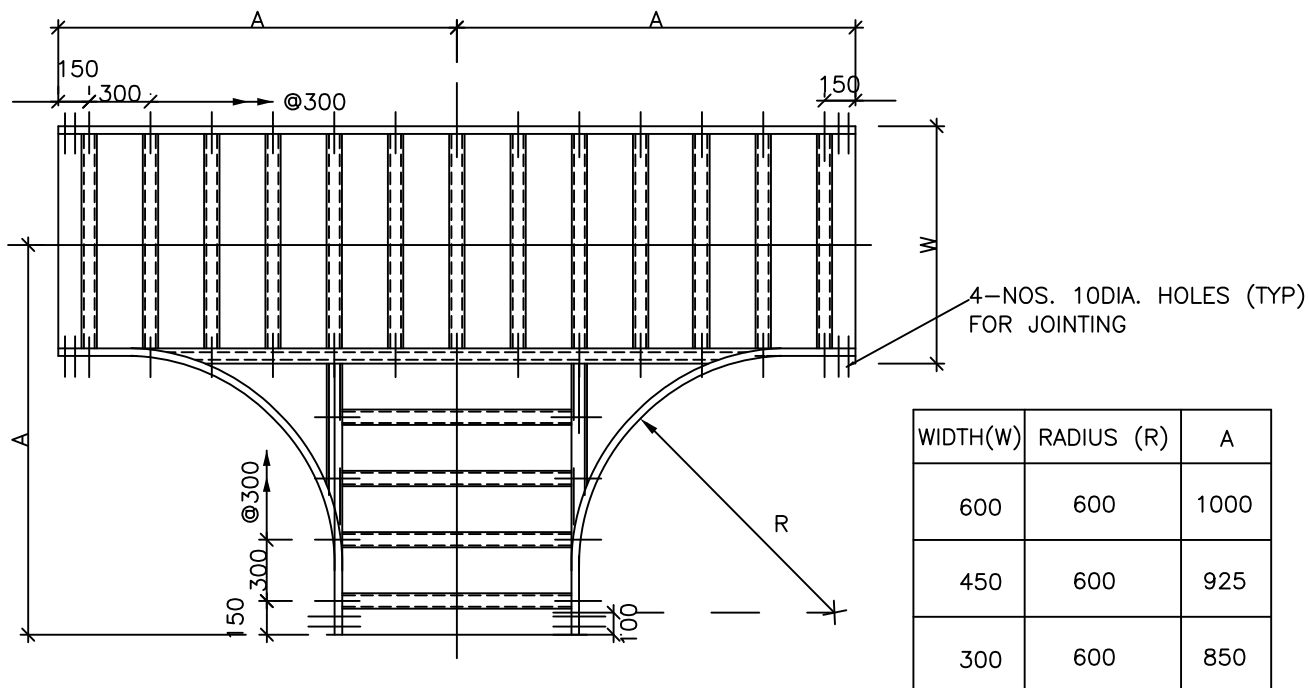
FOR GENERAL NOTES REFER SHEET 26 OF 26



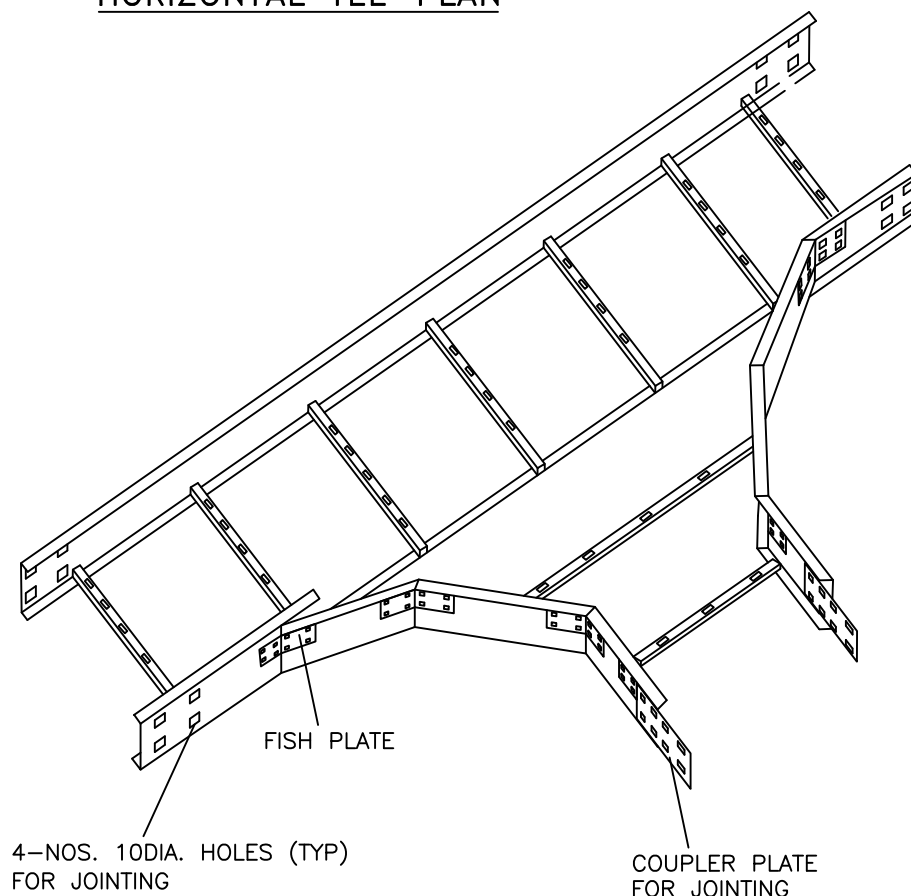
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 17 OF 26 REV. 0



HORIZONTAL TEE-PLAN



HORIZONTAL TEE

LADDER TYPE ACCESSORIES

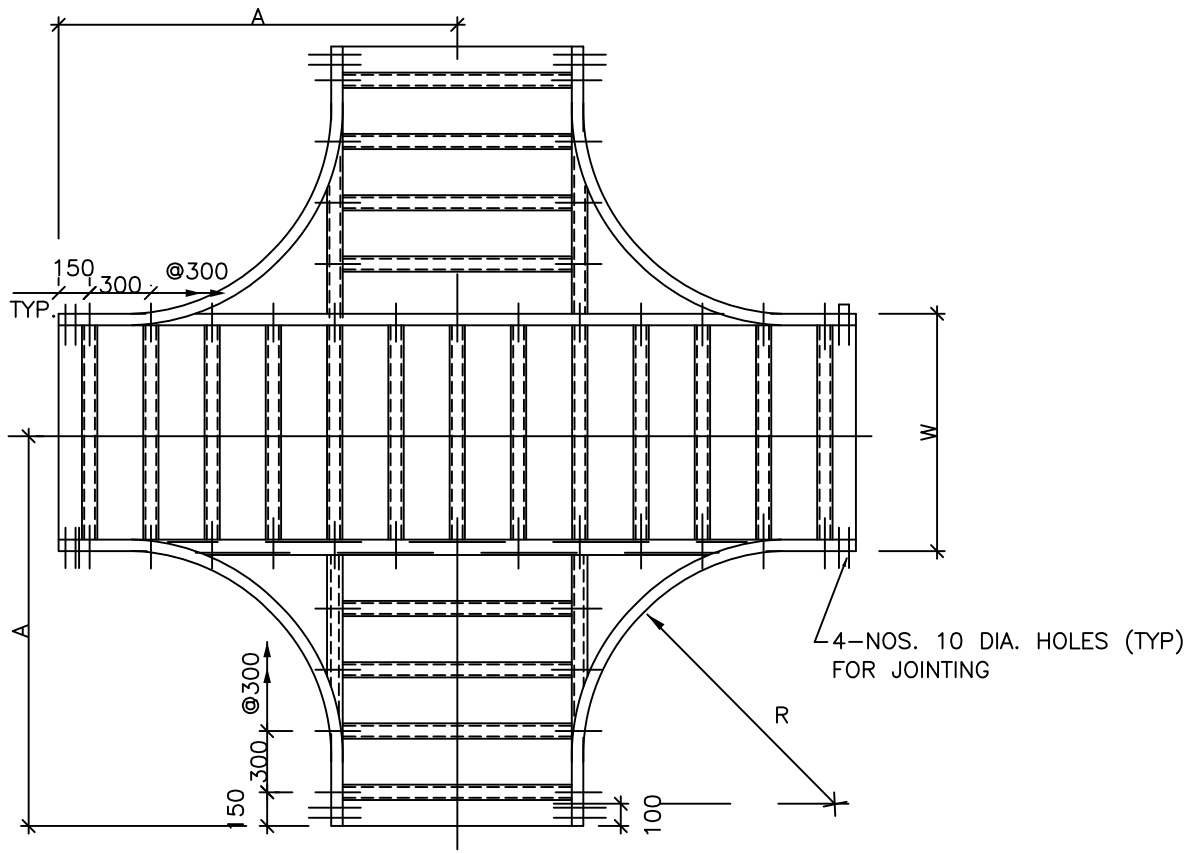
FOR GENERAL NOTES REFER SHEET 26 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

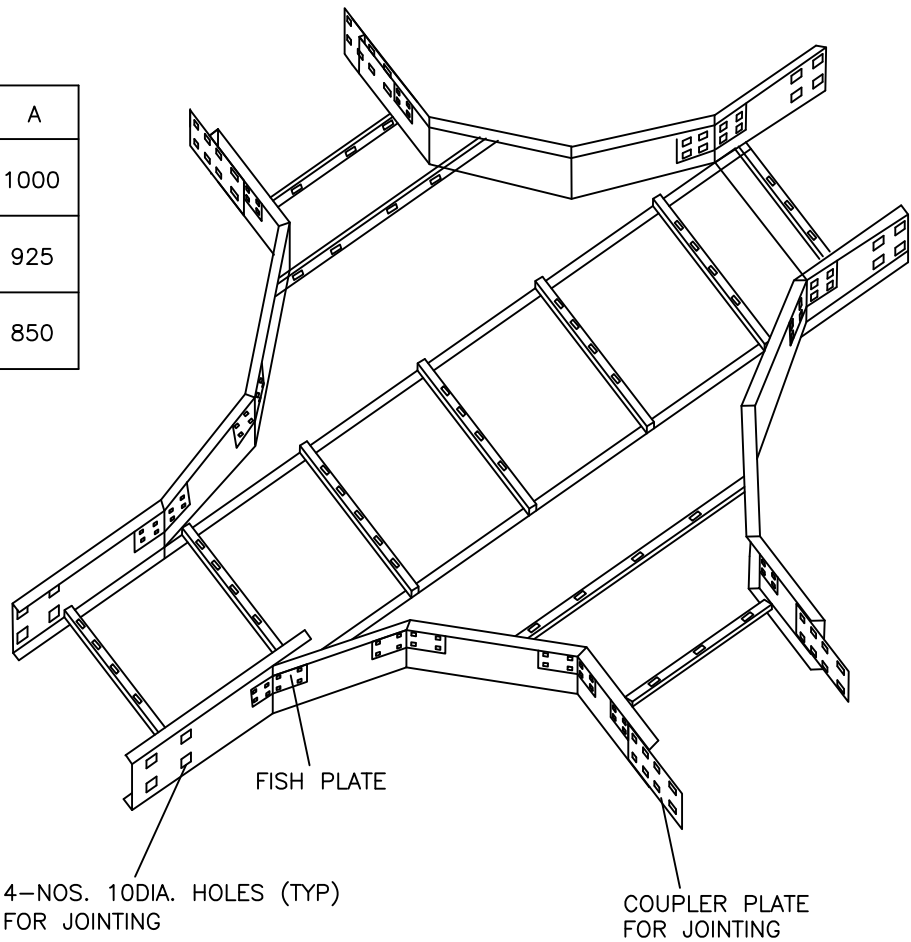
DWG. NO.
PE-DG-435-507-E005

SHT. 18 OF 26 REV. 0



HORIZONTAL CROSS-PLAN

WIDTH(W)	RADIUS (R)	A
600	600	1000
450	600	925
300	600	850



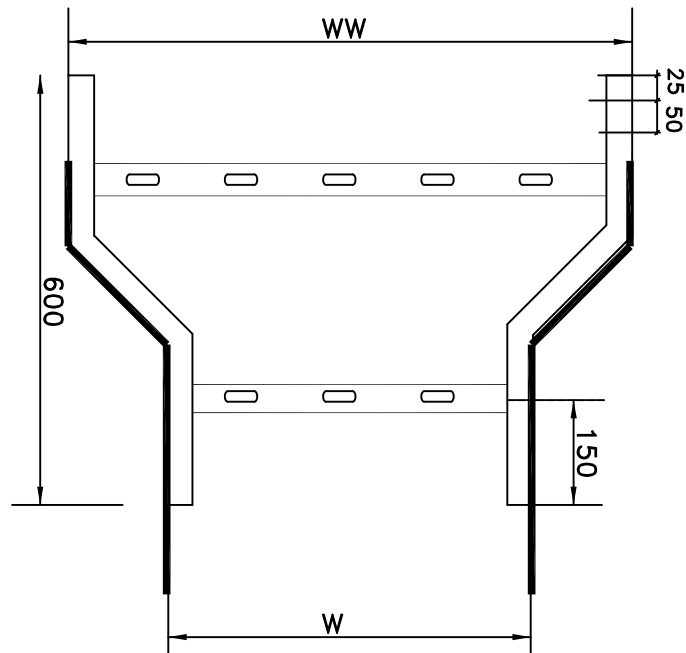
FOR GENERAL NOTES REFER SHEET 26 OF 26



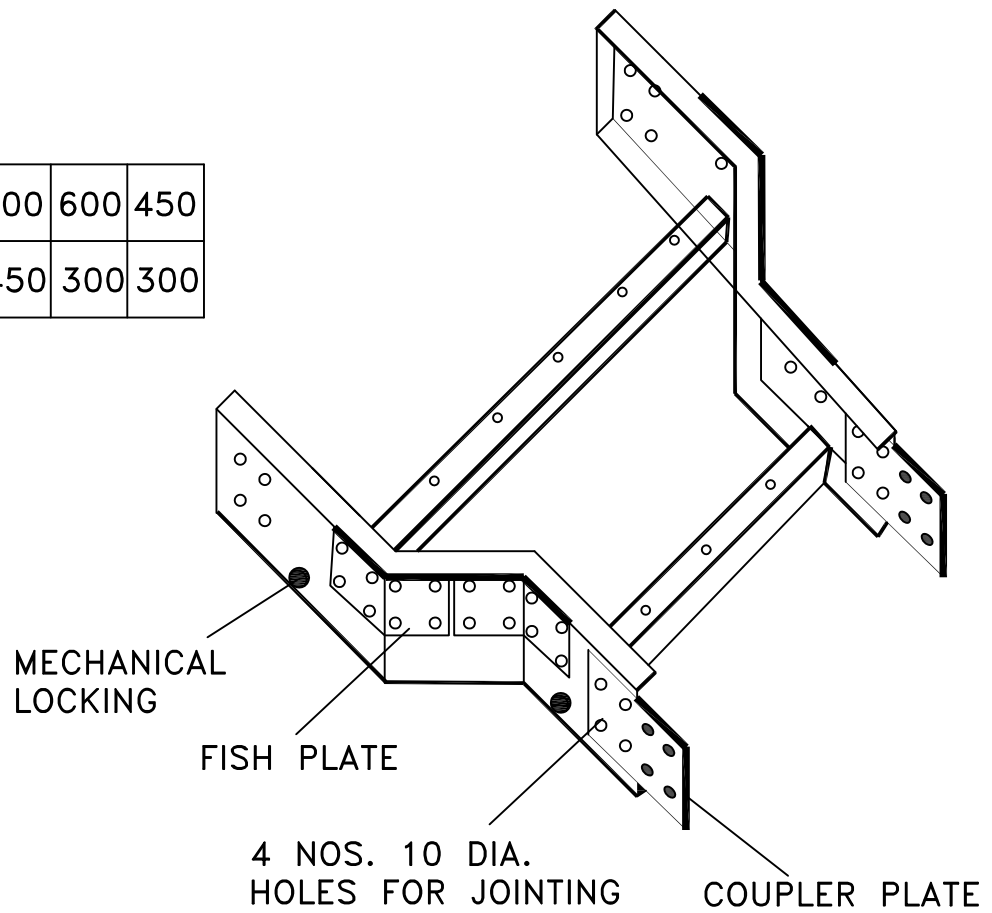
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 19 OF 26 REV. 0



WIDTH	WW	600	600	450
	W	450	300	300



REDUCER-LADDER TYPE

LADDER TYPE ACCESSORIES

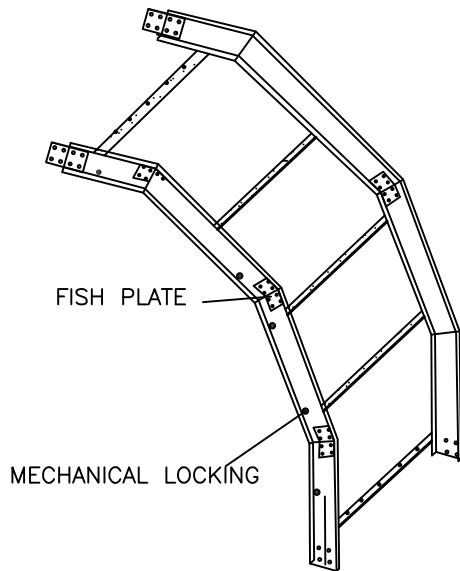
FOR GENERAL NOTES REFER SHEET 26 OF 26



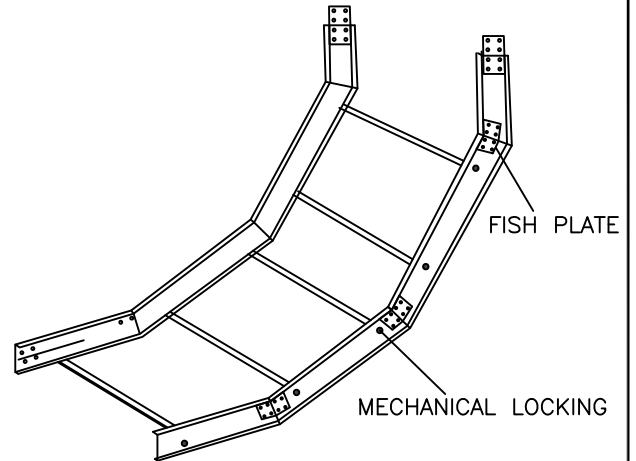
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

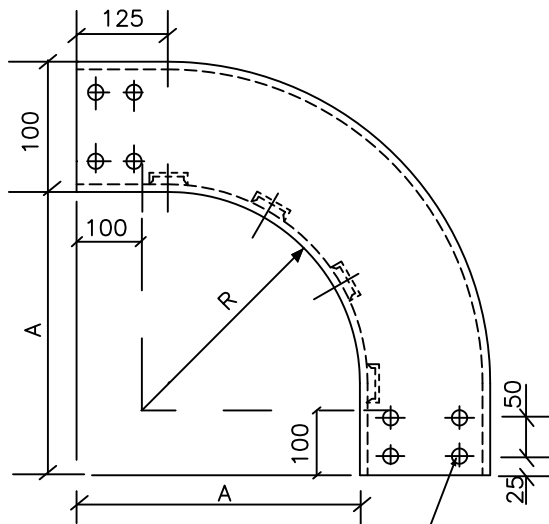
SHT. 20 OF 26 REV. 0



90° VERTICAL BEND
(OUTSIDE)

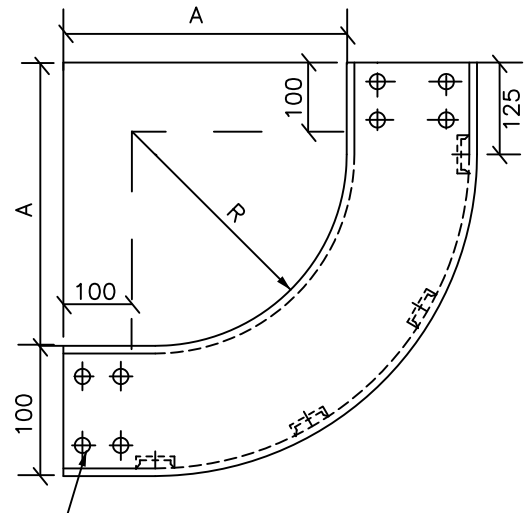


90° VERTICAL BEND
(INSIDE)



ELEVATION
90° VERTICAL BEND
(OUTSIDE)

4 NOS. 10 DIA. HOLES
FOR JOINTING



ELEVATION
90° VERTICAL BEND
(INSIDE)

WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

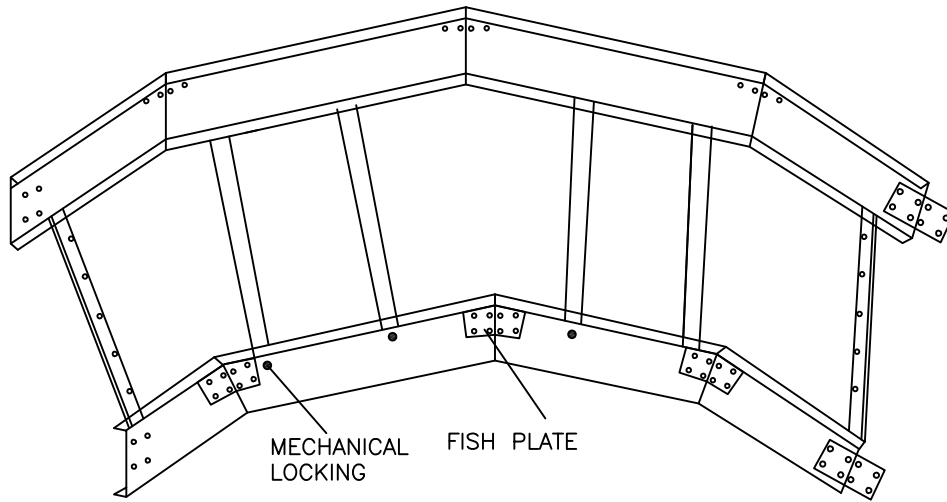
FOR GENERAL NOTES REFER SHEET 26 OF 26



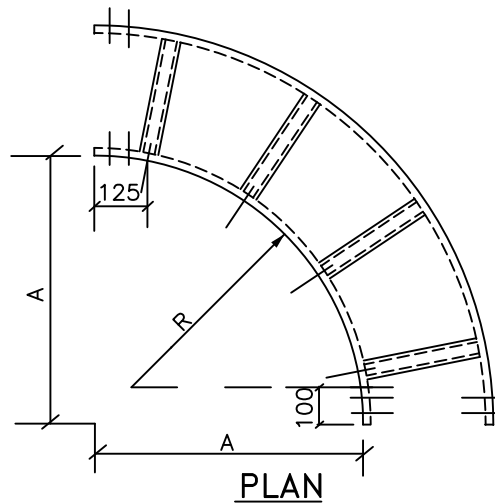
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 21 OF 26 REV. 0



90° HORIZONTAL BEND



90° HORIZONTAL BEND

WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

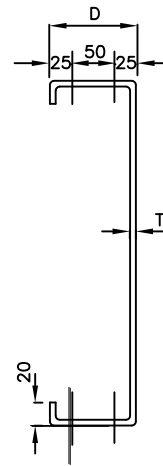
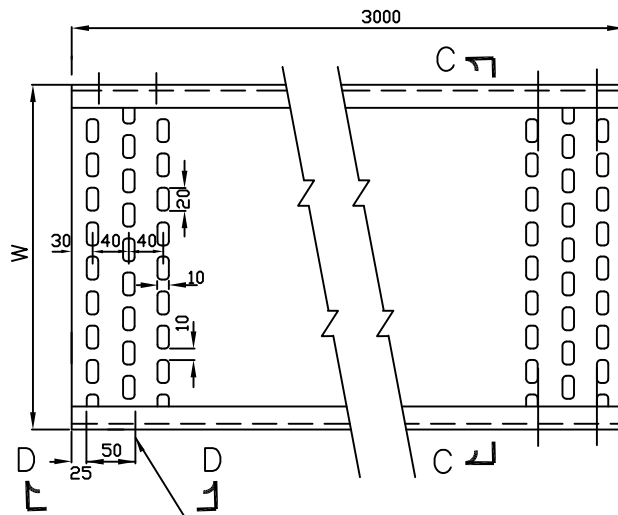
FOR GENERAL NOTES REFER SHEET 26 OF 26



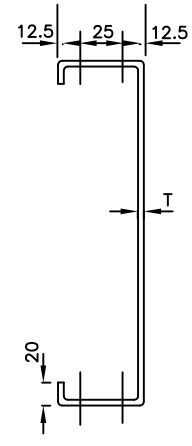
TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 22 OF 26 REV. 0

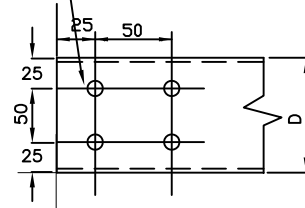


SECTION-CC
(600/450/300/
150 TRAYS)



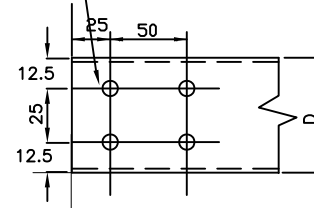
SECTION-CC
(100/50 TRAYS)

4 HOLES 10mm DIA.

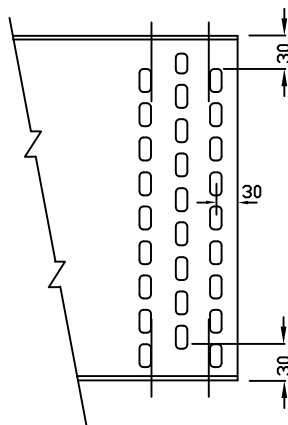


VIEW-DD
(600/450/300/
150W TRAYS)

4 HOLES 10mm DIA.



VIEW-DD
(100W/50W
TRAYS)



ARRANGEMENT OF
PERFORATIONS

TRAY WIDTH W (mm)	600	450	300	150	100	50
TRAY DEPTH D (mm)	100	100	100	100	50	50
T (mm)	4	4	4	4	4	4

PERFORATED TYPE TRAY

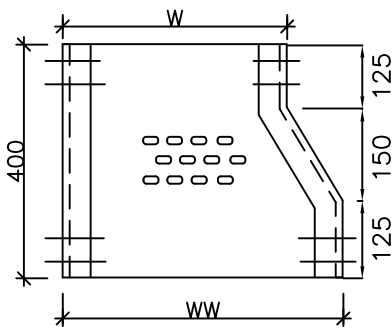
FOR GENERAL NOTES REFER SHEET 26 OF 26



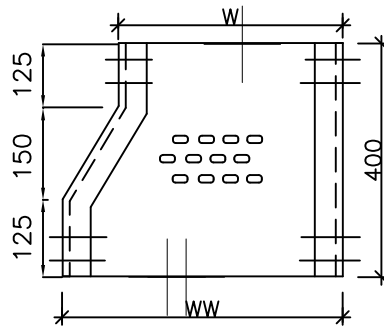
TYPICAL DETAILS OF CABLE TRAYS
AND ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 23 OF 26 REV. 0



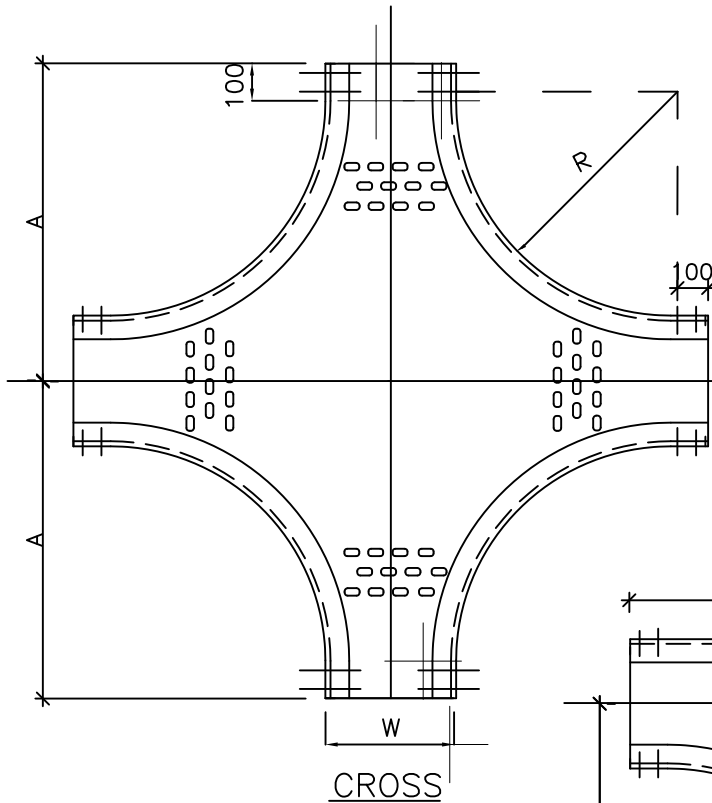
LEFT HAND REDUCER



RIGHT HAND REDUCER

PERFORATED TYPE

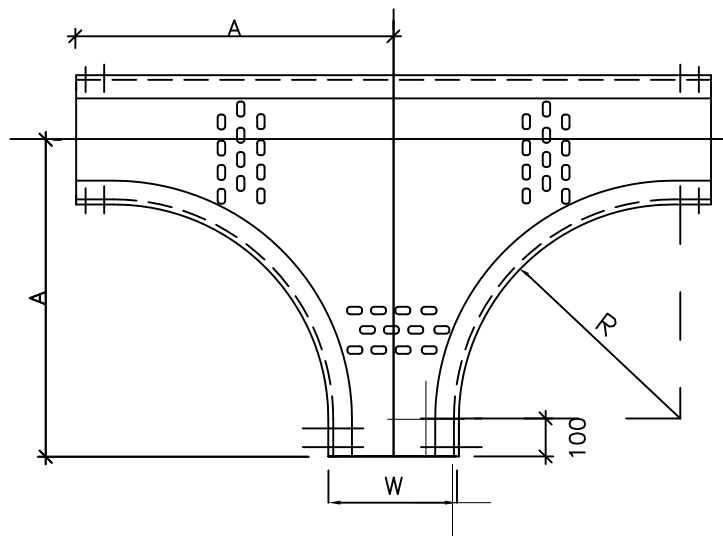
WW	W	DEPTH	THICKNESS
600	450	100	4
600	300	100	4
450	300	100	4



CROSS

PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	THICKNESS
600	600	1000	4
450	600	925	4
300	600	850	4



TEE

PERFORATED TYPE ACCESSORIES

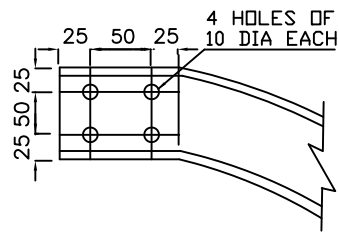
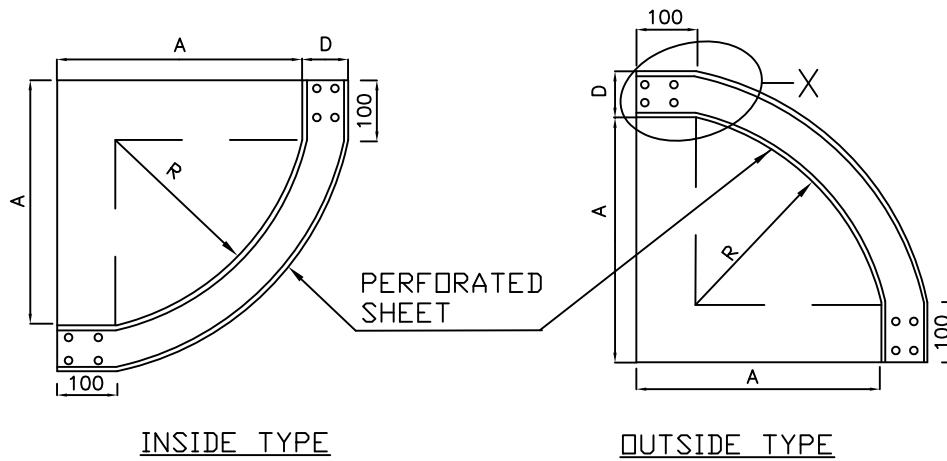
FOR GENERAL NOTES REFER SHEET 26 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

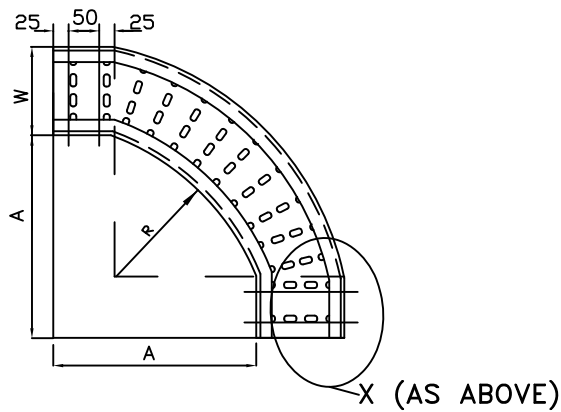
DWG. NO.
PE-DG-435-507-E005

SHT. 24 OF 26 REV. 0



ENLARGED VIEW OF "X"

90° VERTICAL BEND - PERFORATED TYPE



90° HORIZONTAL BEND - PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	700	4
450	600	700	4
300	600	700	4

PERFORATED TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 26 OF 26



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

SHT. 25 OF 26 REV. 0

NOTES:—

1. THE FRP TYPE LADDER AND PERFORATED TYPE CABLE TRAYS AND ACCESSORIES (INCLUDING SIDE RUNNERS OF LADDER TYPE TRAYS & ACCESSORIES) SHALL BE MADE OF 4MM THICKNESS. COUPLER PLATE SHALL BE 4 MM THICK.
2. FOR LADDER TYPE CABLE TRAYS AND ACCESSORIES, ALL RUNGS SHALL BE SLOTTED.
3. STANDARD TRAY ACCESSORIES SHALL BE WITH THE RADIUS INDICATED IN THIS DRAWING.
4. ALL TRAY CORNERS SHALL BE SMOOTH AND FREE OF SHARP EDGES.
5. THE CABLE TRAY COVER (FRP) SHALL BE OF 3MM THICKNESS SHALL BE PROVIDED ON OUTDOOR TRAYS. IT SHALL BE PROVIDED ON TOP MOST CABLE TRAY.
6. THE WIDTH, LENGTH & HEIGHT OF TRAYS & TRAY COVERS SHALL BE WITHIN A TOLERANCE OF (+) 2 mm. THE THICKNESS TOLERANCE SHALL BE (+) 0.5 mm. NO NEGATIVE TOLERANCE IN THICKNESS, WIDTH, HEIGHT OR LENGTH IS PERMITTED.
7. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
8. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE OF STAINLESS STEEL (SS 304).
9. FINISHED TRAYS & COVERS SHALL BE FREE FROM BURRS AND SHARP EDGES.
10. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
11. WIDTH OF CABLE TRAYS PROPOSED TO BE USED FOR THE PROJECT ARE AS UNDER:
A) LADDER TYPE: 600W, 450W, 300W, 150W.
B) PERFORATED TYPE: 600W, 450W, 300W, 150W, 100W, 50W
12. THE DEPTH OF 600W, 450W, 300W, 150W TRAYS & ACCESSORIES SHALL BE 100MM WHILE DEPTH OF 100W & 50W CABLE TRAY SHALL BE 50MM.
13. FOLLOWING SHALL BE LOADING ON CABLE TRAYS AT 1500MM SUPPORT SPAN:—
FOR LADDER TYPE CABLE TRAYS:—
600W CABLE TRAY — 90KG/M
450W CABLE TRAY — 75KG/M
300W CABLE TRAY — 60KG/M
150W CABLE TRAY — 30KG/M

FOR PERFORATED TYPE CABLE TRAYS:—
600W CABLE TRAY — 90KG/M
450W CABLE TRAY — 75KG/M
300W CABLE TRAY — 60KG/M
150W CABLE TRAY — 30KG/M
100W CABLE TRAY — 15KG/M
50W CABLE TRAY — 7.5KG/M

IN ADDITION TO THIS 80KG POINT LOAD AT MID SPAN SHALL ALSO BE CONSIDERED.



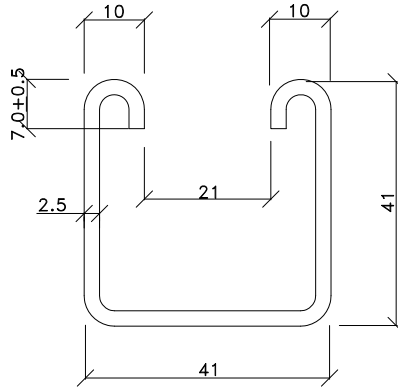
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES (FRP TYPE)

DWG. NO.
PE-DG-435-507-E005

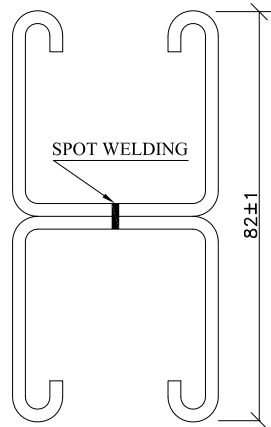
SHT. 26 OF 26 REV. 0

INSTALLATION DETAILS FOR
CABLE TRAY SUPPORT SYSTEM
(BOLTABLE TYPE)

CUSTOMER	TAMIL NADU GENERATION & DISTRIBUTION CORPORATION LIMITED					
PROJECT	2 X 660 MW UDANGUDI STPP STAGE-I					
JOB NO. 435	 BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA	DPT CODE-E	DRN	NAME	SIGN	DATE
			DSN	SKS		
			CHD	VY		
			APP	SL		
		DWG. NO. PE-DG-435-507-E006				
	SHT. 01 OF 20					REV. 0



SINGLE CHANNEL SC1



DOUBLE CHANNEL DC1

TWO LENGTHS OF SINGLE CHANNEL

SPOT WELDED BACK TO BACK

AT 75MM C/C

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : HOT ROLLED M.S. AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT
MATERIAL & ACCESSORIES

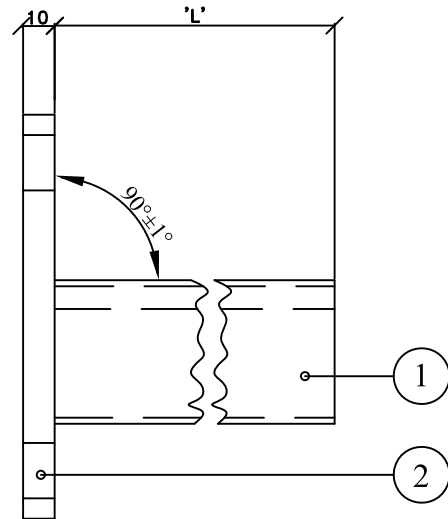
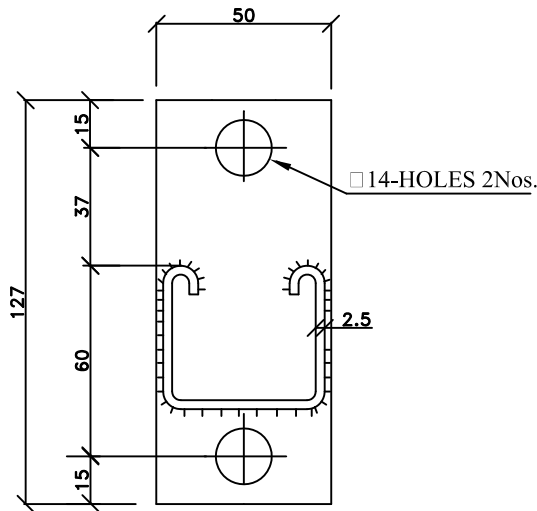


TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

DRG. NO.

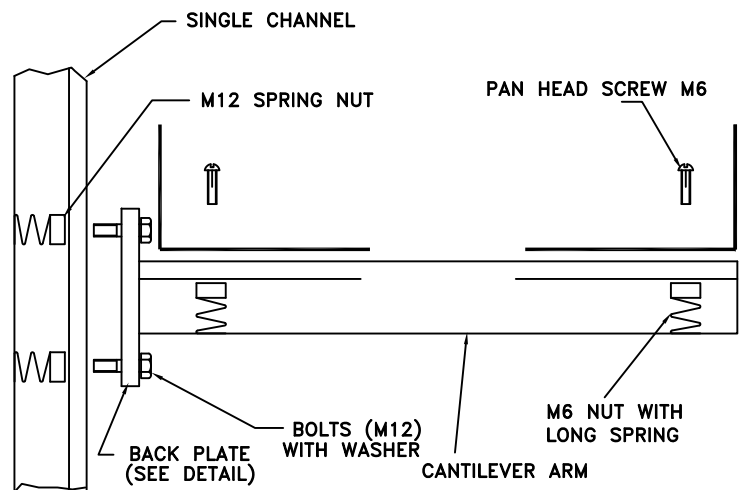
PE-DG-435-507-E006

SH 2 OF 20



CANTILEVER ARMS

TRAY WIDTH IN MM	CANTILEVER ARM LENGTH (L) IN MM
150	200
300	350
450	500
600	650



TYPICAL ASSEMBLY OF CHANNEL SUPPORTS AND CABLE TRAY

M12 HEX BOLT & WASHER-2Nos.
M12 SPRING NUTS-2Nos.
M6 PAN HEAD SCREWS & WASHER-2Nos.
M6 SPRING NUTS-2Nos.

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. ITEM NO.1 MATERIAL : HOT ROLLED M.S. AS PER IS-2062.
3. ITEM NO.2 MATERIAL : MILD STEEL AS PER IS-2062.
4. FINISH : HOT DIP GALVANISED AS PER IS 2629
5. TOLERANCE ON THICKNESS IS AS PER IS 1852
6. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
7. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES

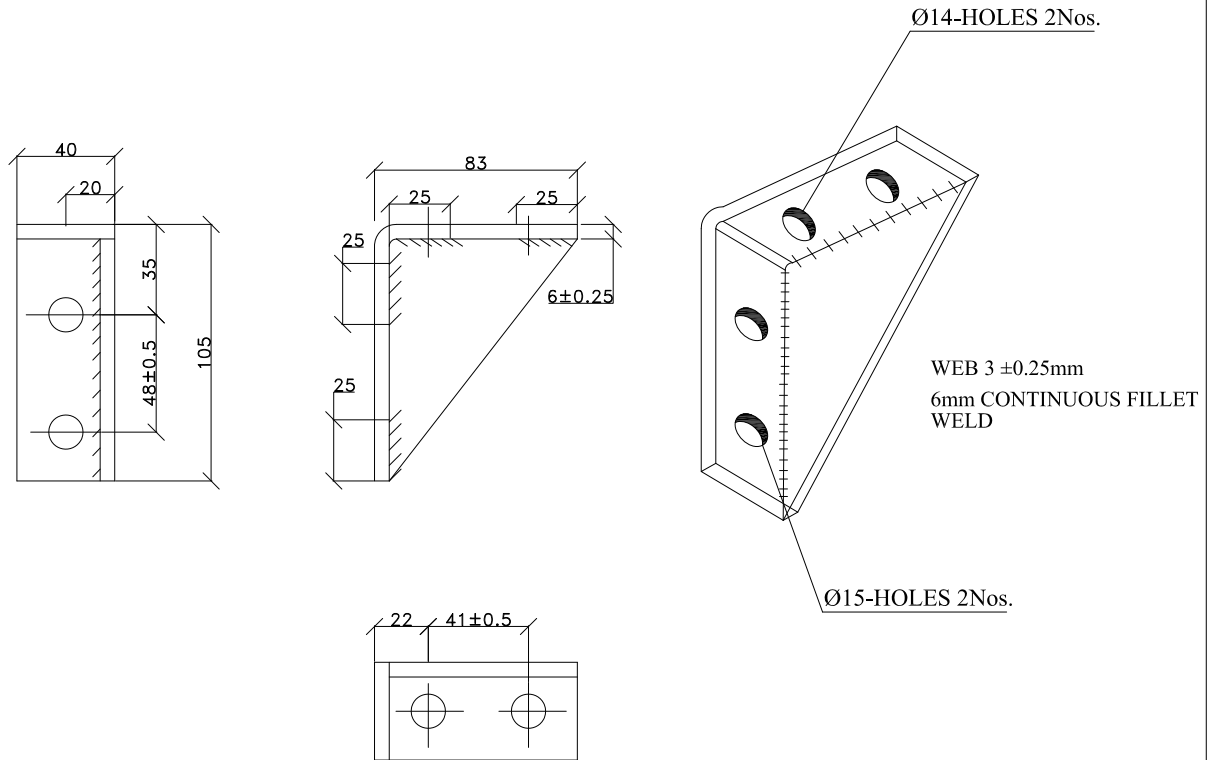


**TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM**

DRG. NO.

PE-DG-435-507-E006

SH 3 OF 20



90° ANGLE FITTING HL1

*ANCHOR FASTENER-2Nos.
SPRING NUT & WASHER-2Nos.*

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES

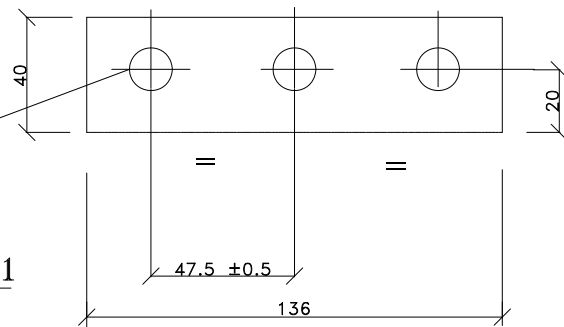
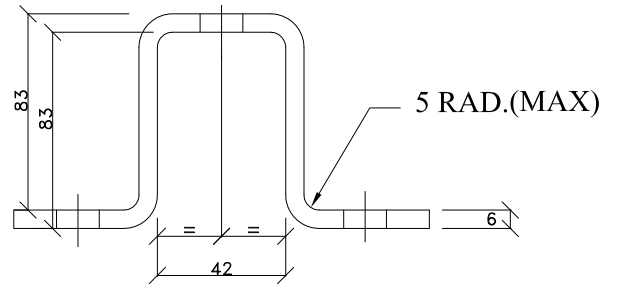
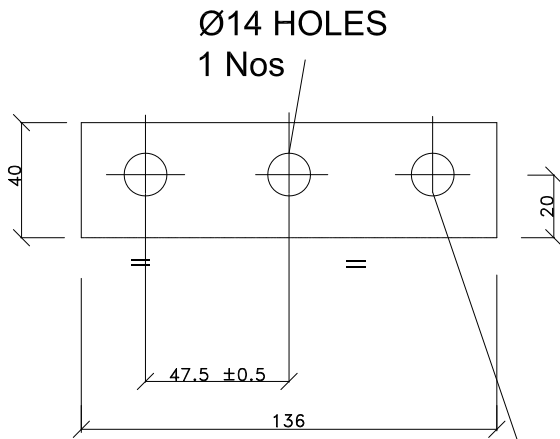
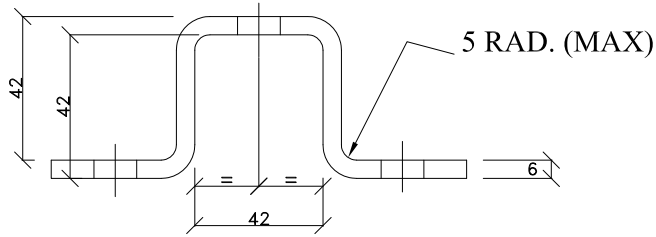
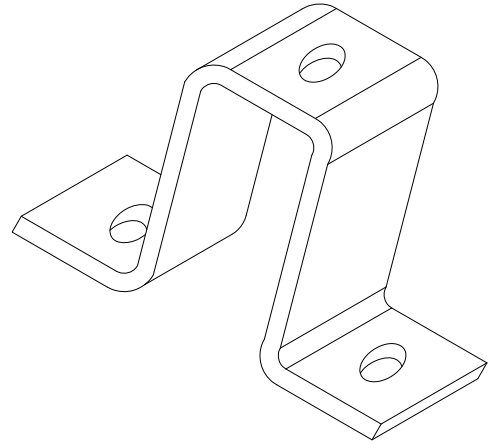
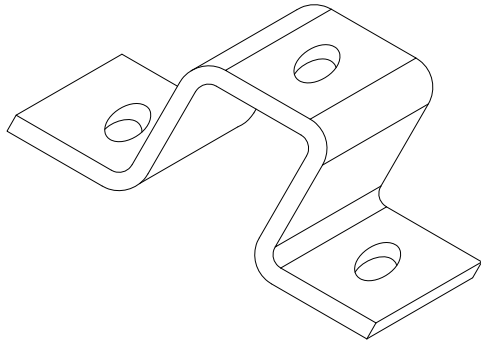


TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

DRG. NO.

PE-DG-435-507-E006

SH 4 OF 20



CLAMP FOR SINGLE CHANNEL CC1

CLAMP FOR DOUBLE CHANNEL CC2

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

*ANCHOR FASTENER-2NOS.
SPRING NUT & WASHER-1NO.*

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT
MATERIAL & ACCESSORIES

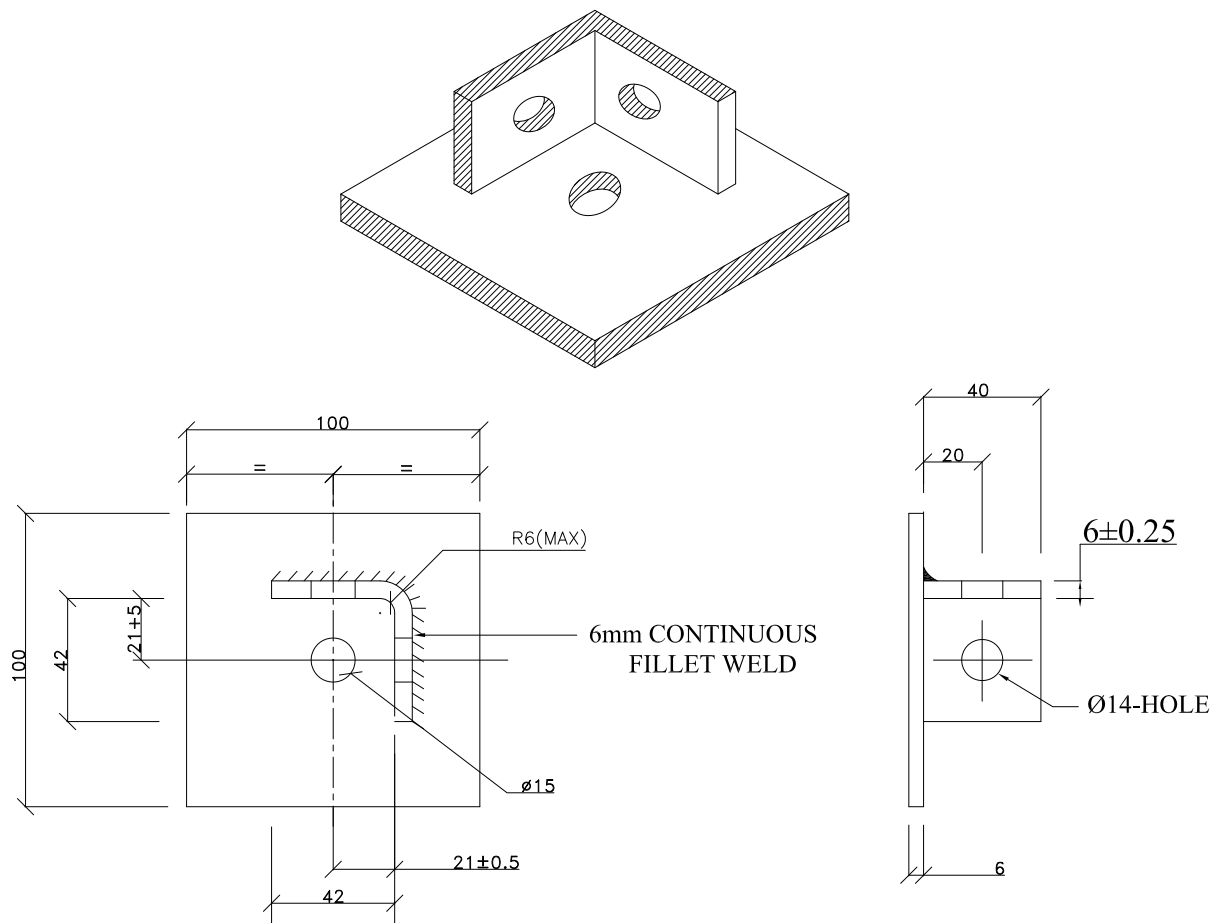


TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

DRG. NO.

PE-DG-435-507-E006

SH 5 OF 20



BASE PLATE FOR SINGLE CHANNEL BP1

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

*ANCHOR FASTENER-1NO.
SPRING NUT & WASHER-1NO.*

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES

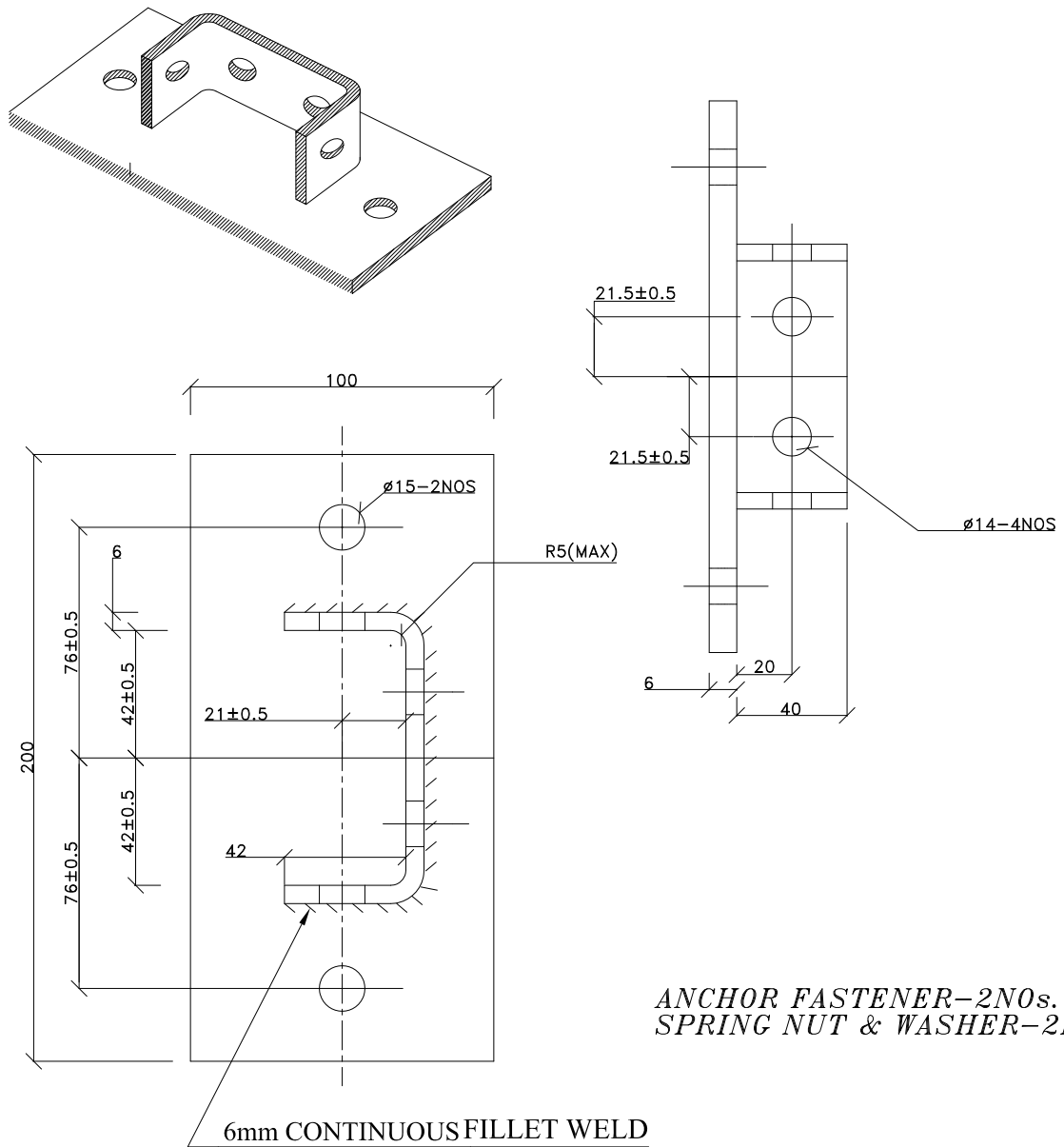


TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

DRG. NO.

PE-DG-435-507-E006

SH 6 OF 20



BASE PLATE FOR DOUBLE CHANNEL BP2

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES



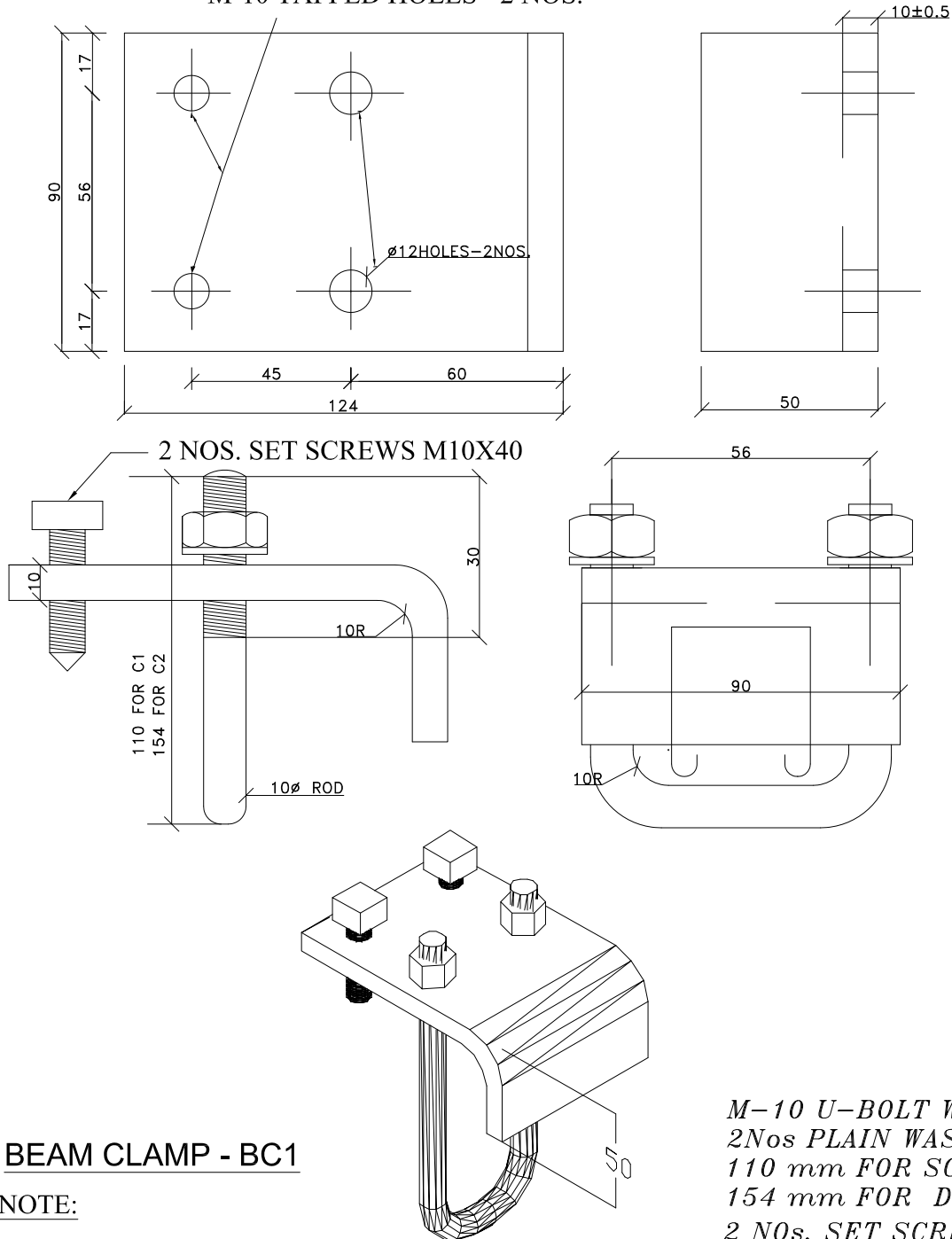
TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

DRG. NO.

PE-DG-435-507-E006

SH 7 OF 20

M-10 TAPPED HOLES - 2 NOS.



BEAM CLAMP - BC1

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

M-10 U-BOLT WITH
2Nos PLAIN WASHERS & NUTS
110 mm FOR SC 1
154 mm FOR DC1
2 NOS. SET SCREWS M10X40

TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES

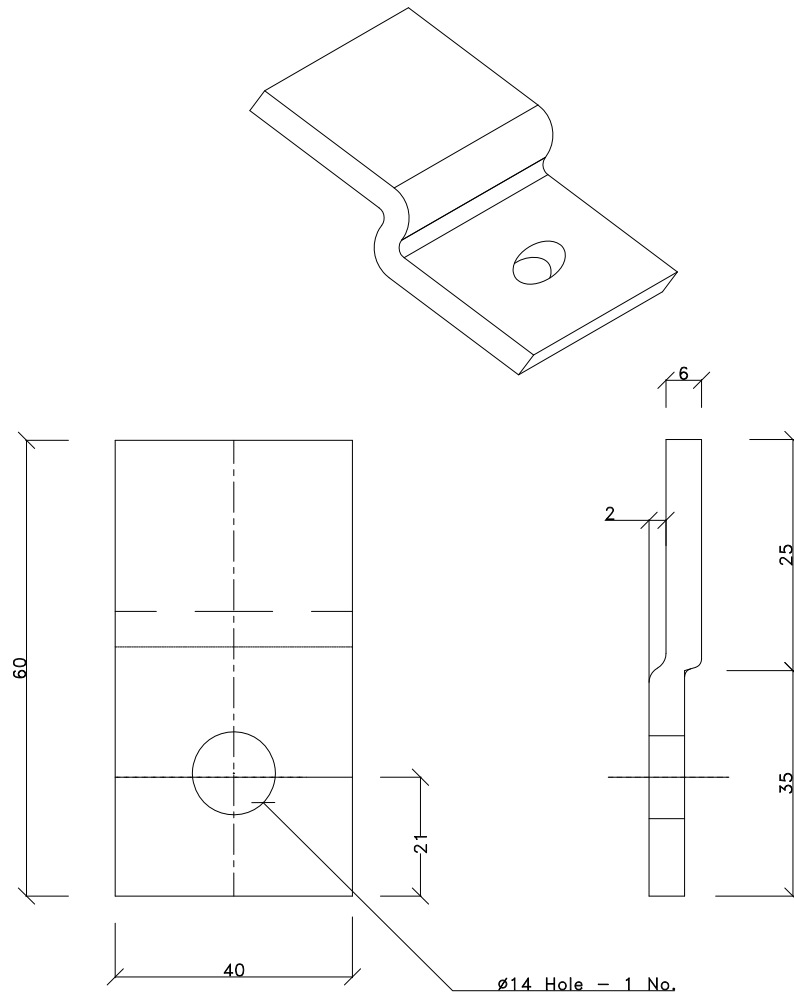


TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

BHEL DRAWING NO.

PE-DG-435-507-E006

SH 8 OF 20



TRAY FIXING CLAMP - TC1

NOTE:

SPRING NUT & WASHER-1 NO.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

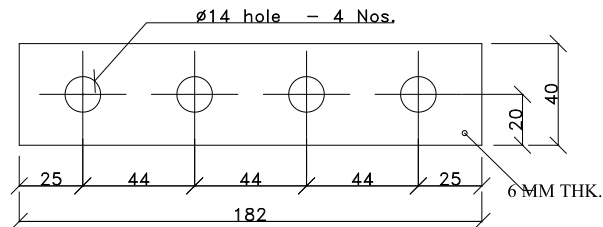
TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES



TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

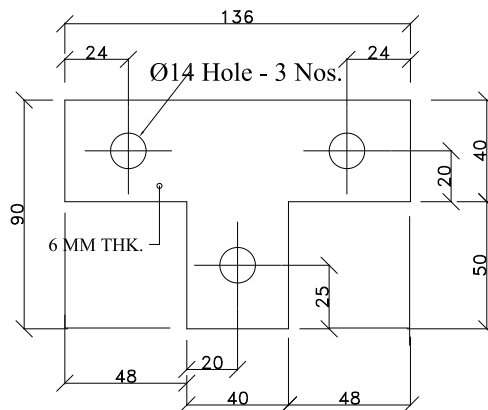
BHEL DRAWING NO.
PE-DG-435-507-E006

SH 9 OF 20



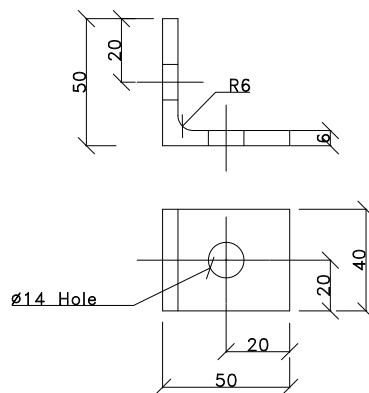
SPRING NUT & WASHER-4Nos.

FLAT PLATE STRAIGHT FITTING PF2



SPRING NUT & WASHER-3Nos.

FLAT PLATE TEE FITTING PF1



SPRING NUT & WASHER-2Nos.

NOTE:

90° ANGLE FITTING LA1

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MILD STEEL AS PER IS-2062.
3. FINISH : HOT DIP GALVANISED AS PER IS 2629
4. TOLERANCE ON THICKNESS IS AS PER IS 1852
5. ALL FABRICATION TOLERANCE AS PER RELEVANT IS.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.

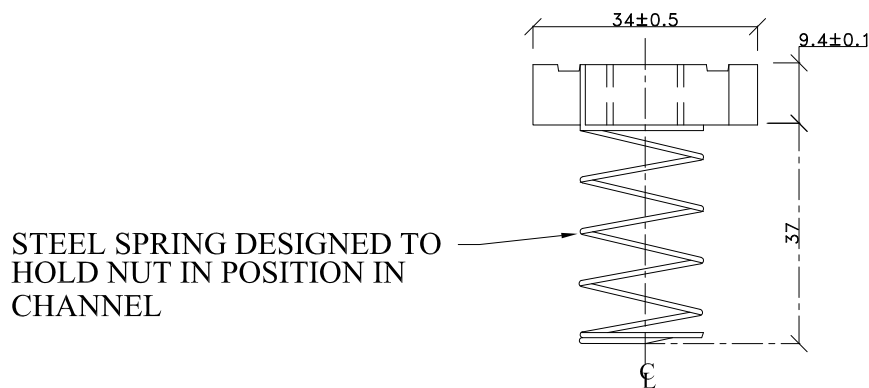
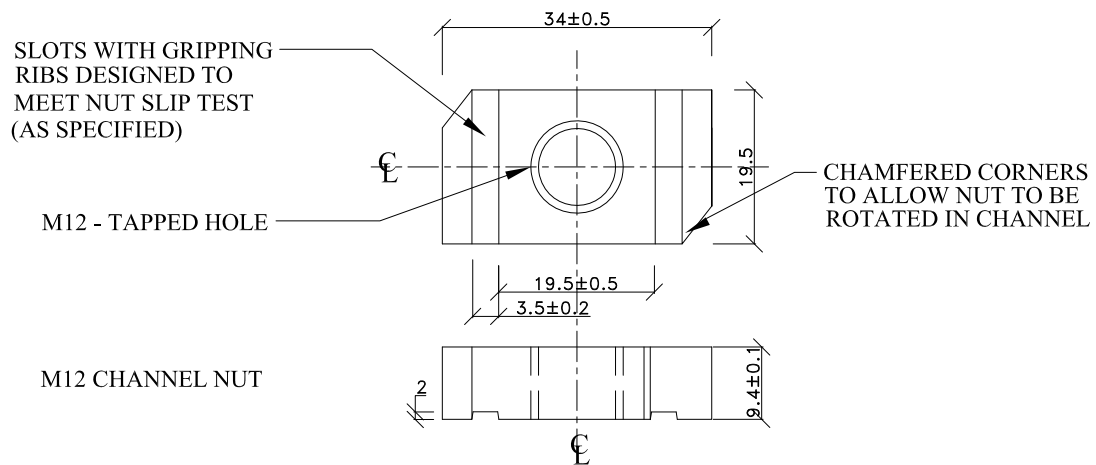
TYPICAL DETAILS OF BOLTABLE TYPE CABLE TRAY SUPPORT MATERIAL & ACCESSORIES



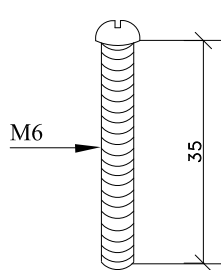
TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

BHEL DRAWING NO.
PE-DG-435-507-E006

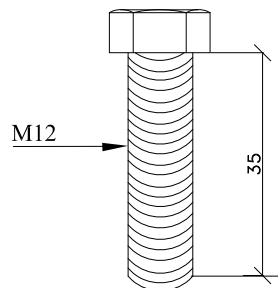
SH 10 OF 20



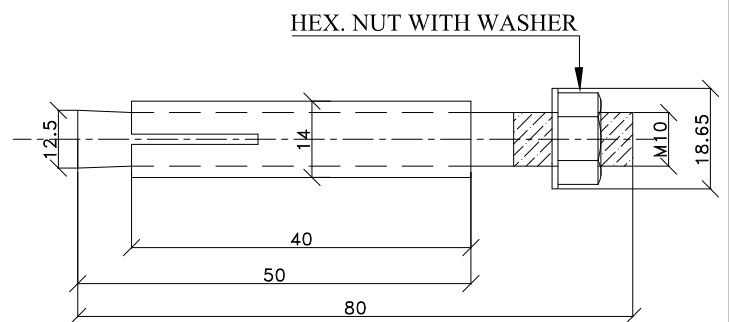
SPRING NUT ASSEMBLY



PAN HEAD SCREW



HEX BOLT



ANCHOR BOLT M10

NOTES:

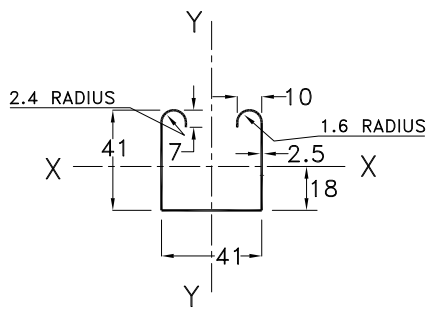
1. MATERIAL - MS AS PER IS - 2062.
2. M6 CHANNEL NUT DIMENSIONAL SIMILAR TO M12.
EXCEPT HOLE DRILLED AND TAPPED TO M6 PAN HEAD SCREWS.
3. TAPPED HOLE THREADING TO MATCH WITH THREADING OF BOLTS.
4. SURFACE PROTECTION ELECTROGALVANISED / CADMIUM PLATED.
5. ALL DIMENSIONS ARE IN MM.
6. ZINC COATING SHALL BE MIN. 75 MICRON/ 610 G/SQ.M.



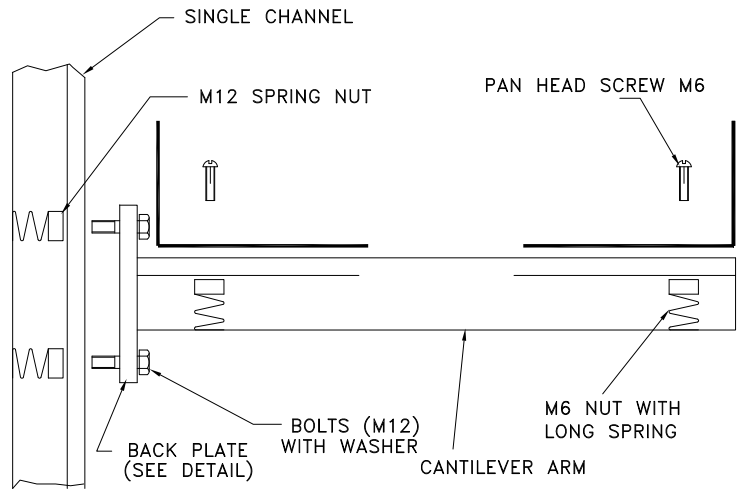
TITLE: INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT
SYSTEM

BHEL DRAWING NO.

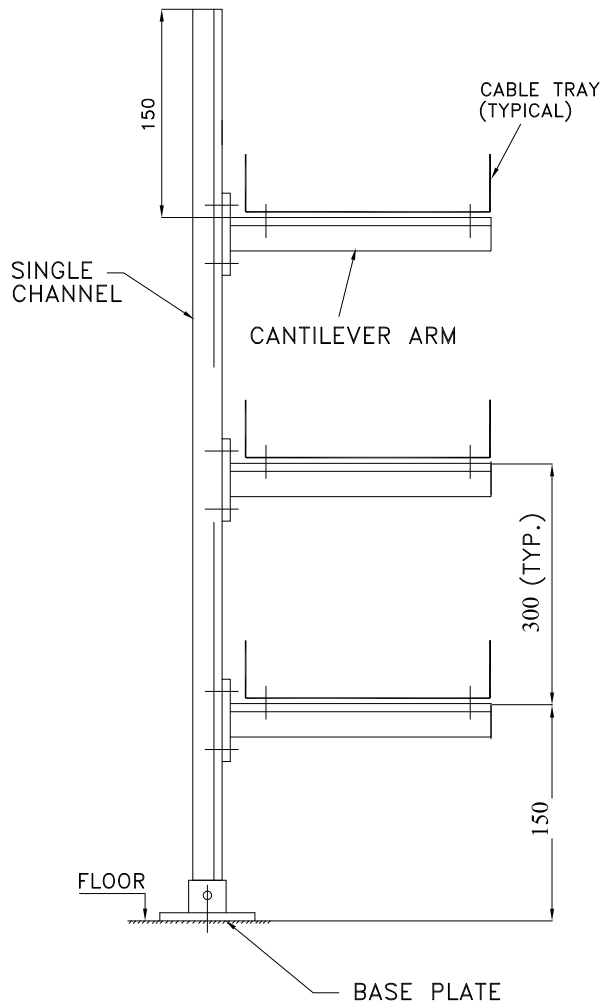
PE-DG-435-507-E006



DETAIL OF ITEM-1
(SINGLE CHANNEL)

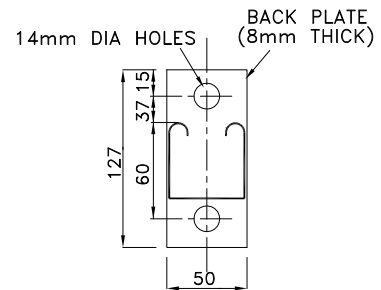


TYPICAL ASSEMBLY OF CHANNEL
SUPPORTS AND CABLE TRAY

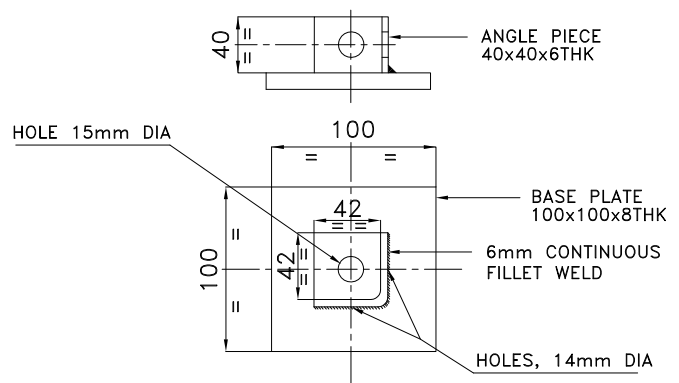


FLOOR SUPPORTED (SINGLE SIDE TYPE)

SEE GENERAL NOTES IN SHEET 17.



END VIEW OF
(CANTILEVER ARM)



DETAILS OF BASE PLATE
FOR SINGLE CHANNEL



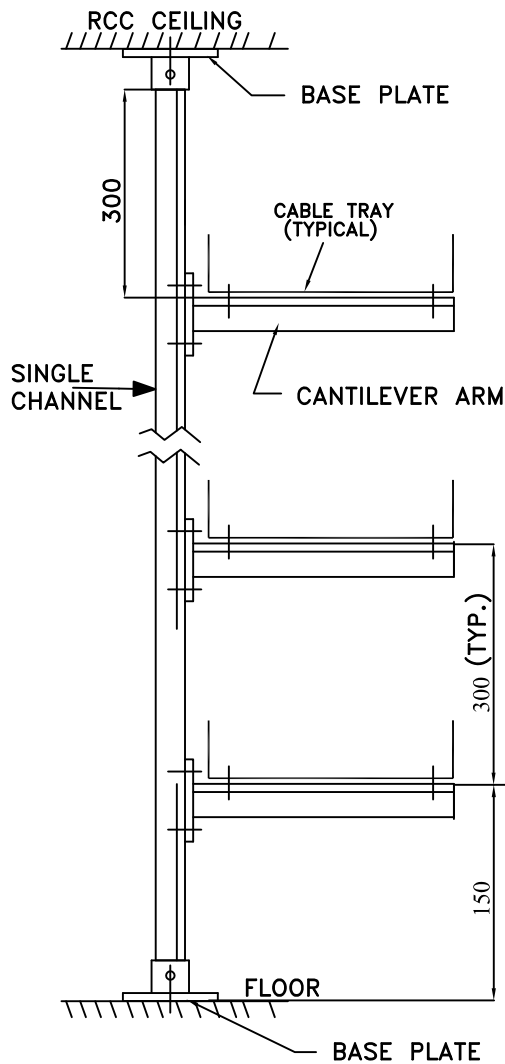
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

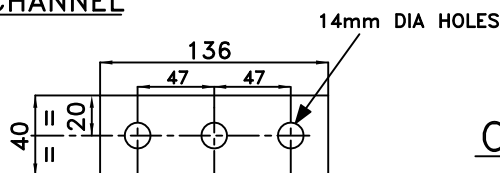
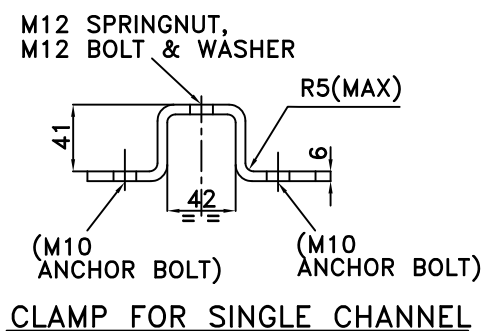
BHEL DRAWING NO.

PE-DG-435-507-E006

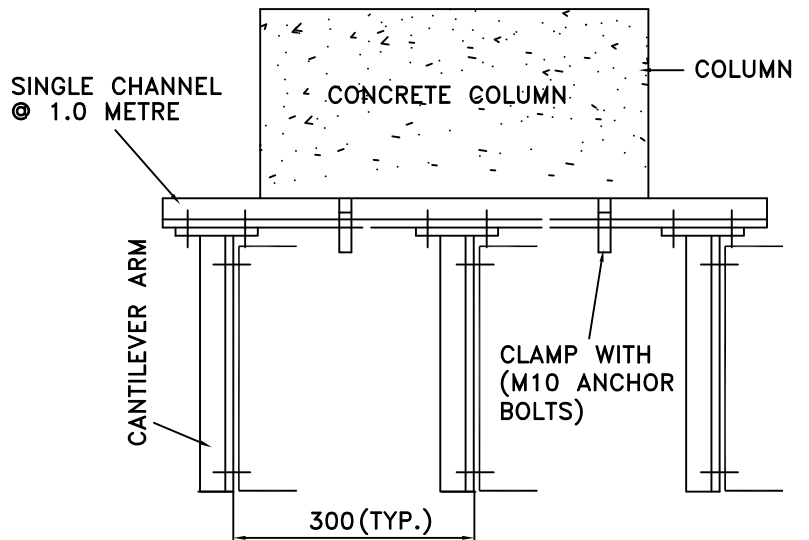
SH 12 OF 20



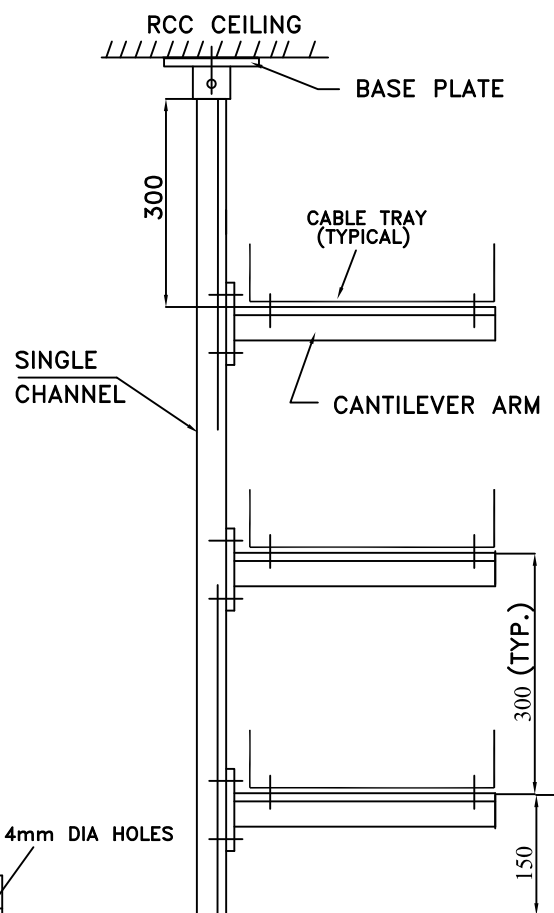
**SUPPORTING ARRANGEMENT
BETWEEN FLOOR AND CEILING
(SINGLE SIDE TYPE)**



SEE GENERAL NOTES IN SHEET 17.



**SUPPORT ARRANGEMENT
FROM BUILDING COLUMN**



**CEILING SUPPORTED
(SINGLE SIDE TYPE)**



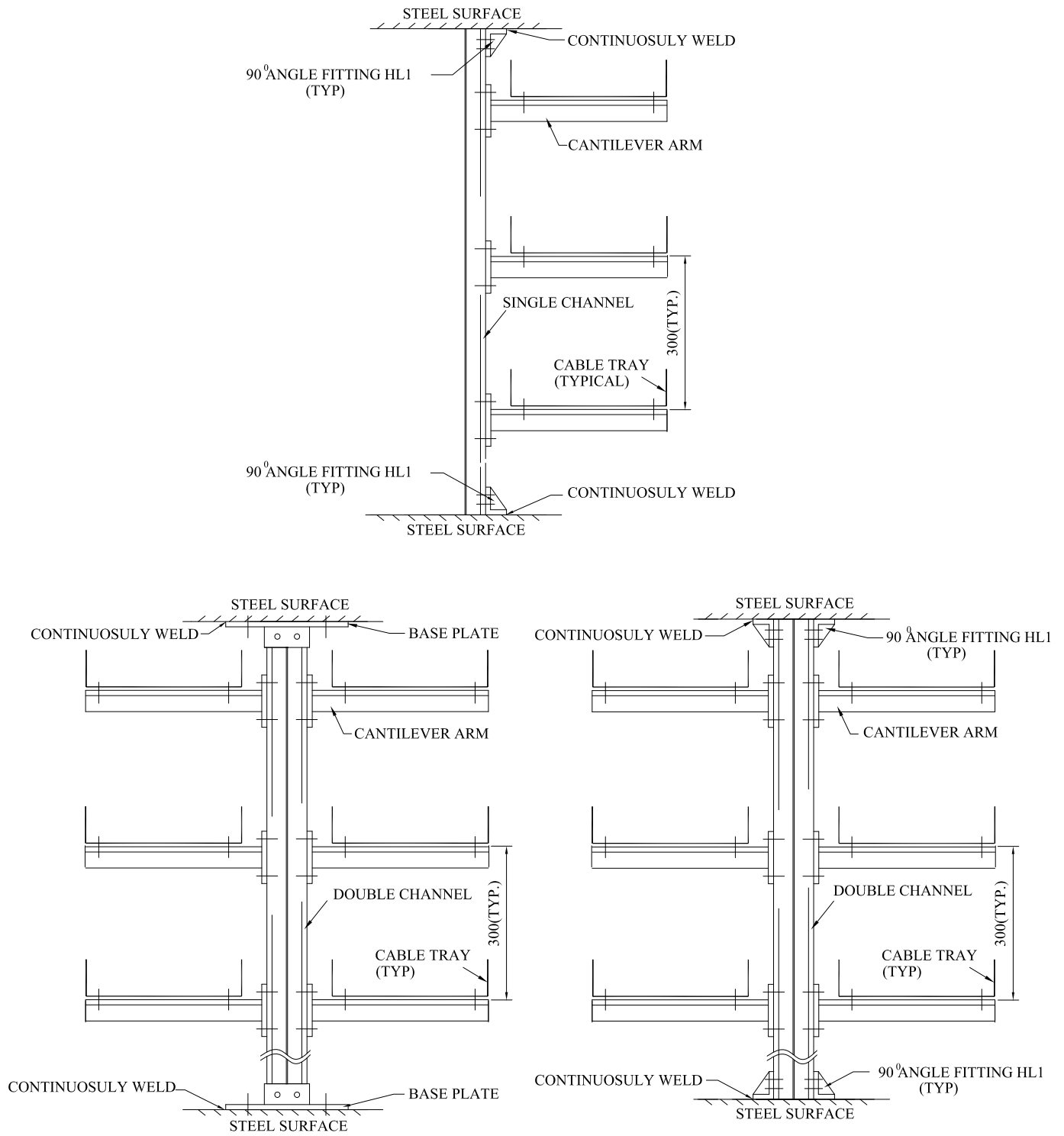
TITLE:

**INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM**

BHEL DRAWING NO.

PE-DG-435-507-E006

SH 13 OF 20



SUPPORTING ARRANGEMENT
OF (SINGLE SIDE/DOUBLE SIDE)
BETWEEN TWO STEEL SURFACE

SEE GENERAL NOTES IN SHEET 17.

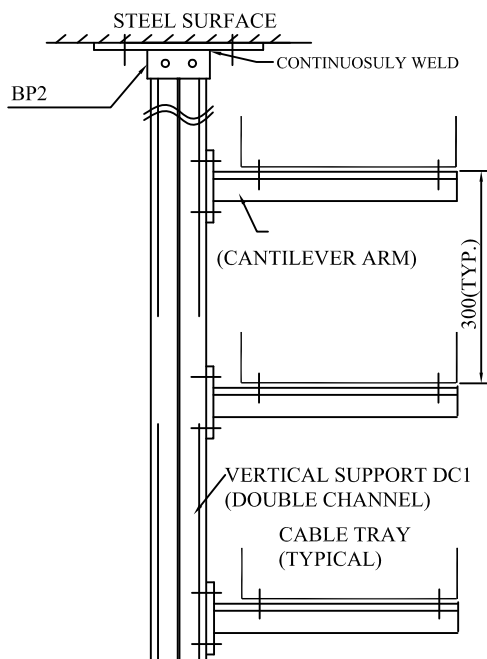


TITLE: INSTALLATION DETAILS FOR
 CABLE TRAYS SUPPORT SYSTEM

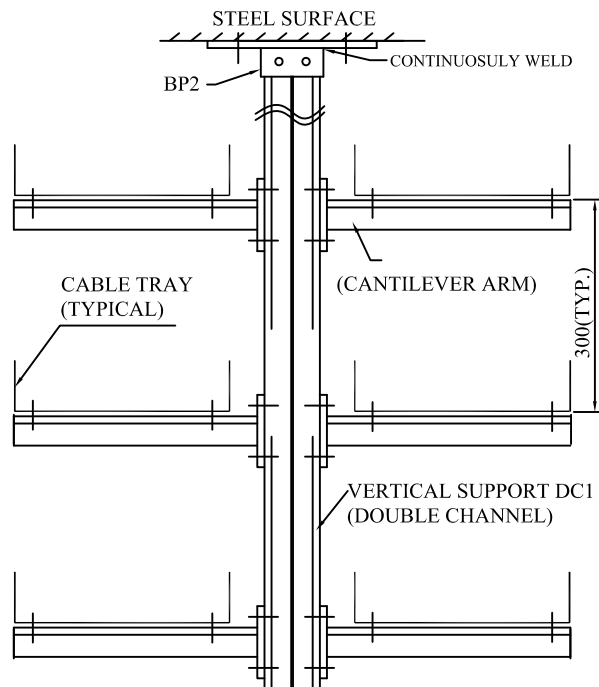
BHEL DRAWING NO.

PE-DG-435-507-E006

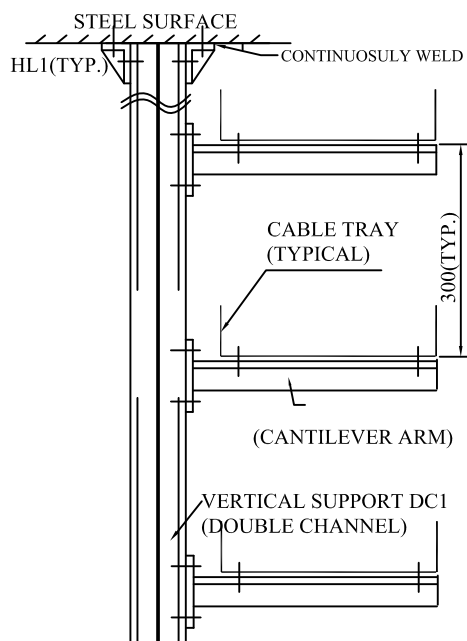
SH 14 OF 20



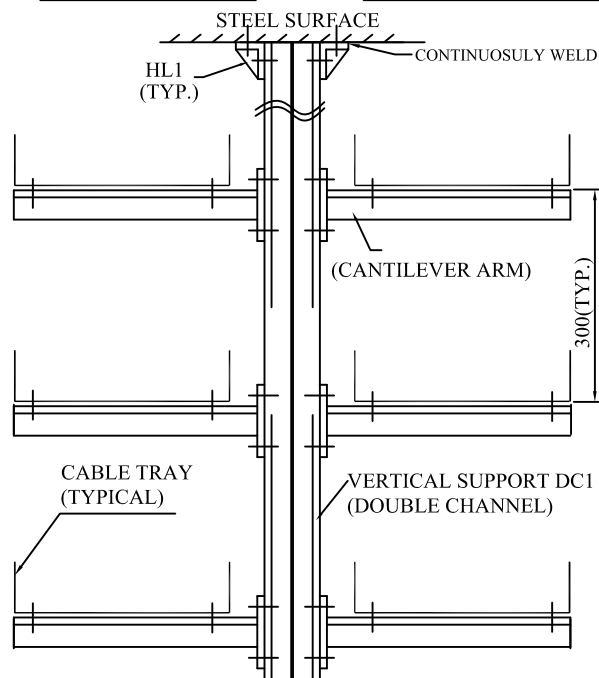
INSTALLATION DETAIL TYPE DS1:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
BASEPLATE AT TOP
APPLICABLE FOR THREE TRAYS ON SINGLE SIDE



INSTALLATION DETAIL TYPE DS2:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
BASEPLATE AT TOP
APPLICABLE FOR UPTO THREE TRAYS ON BOTH SIDES



INSTALLATION DETAIL TYPE DS3:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
WITH ANGLE FITTING HL1 AT TOP
APPLICABLE FOR MORE THAN TWO TRAYS
ON SINGLE SIDE



INSTALLATION DETAIL TYPE DS4:
DOUBLE CHANNEL SUPPORT INSTALLATION
ONLY TOP END FIXED
WITH ANGLE FITTING HL1 AT TOP
APPLICABLE FOR UPTO THREE TRAYS ON BOTH SIDES

SEE GENERAL NOTES IN SHEET 17.

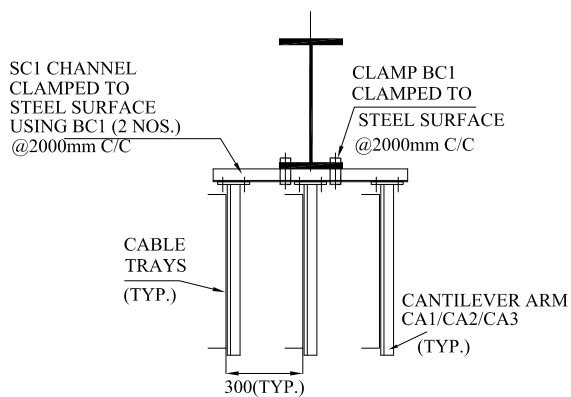
TITLE:

**INSTALLATION DETAILS FOR
 CABLE TRAYS SUPPORT SYSTEM**

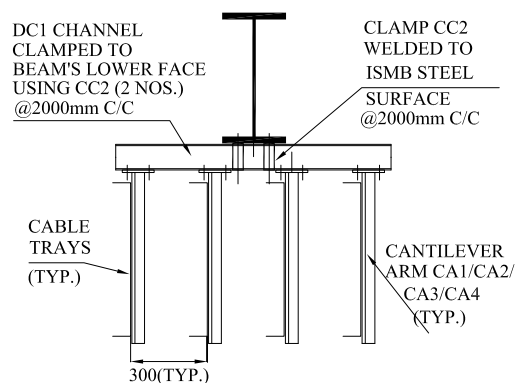
BHEL DRAWING NO.

PE-DG-435-507-E006

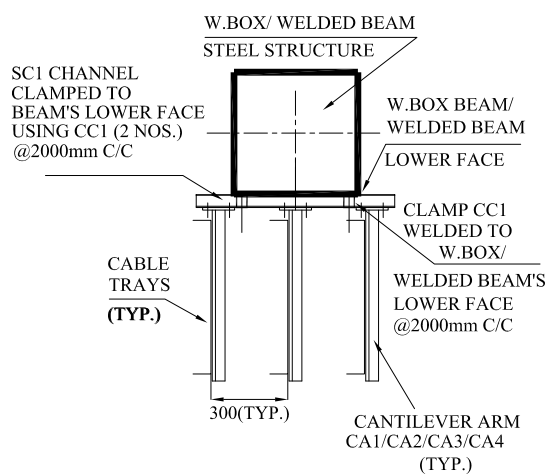




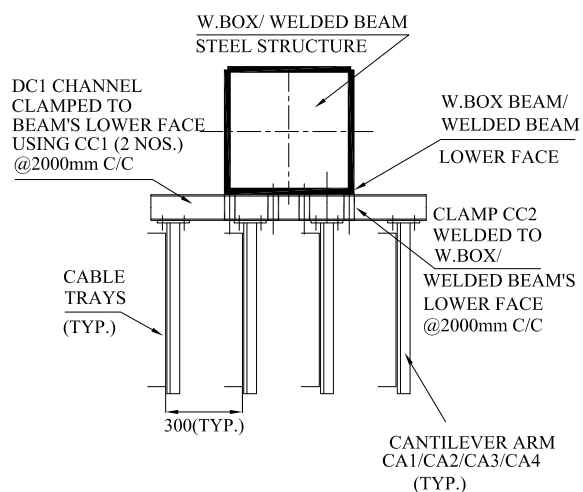
INSTALLATION DETAIL TYPE BB1:
CABLE TRAYS BELOW I-BEAMS
(UPTO & INCLUDING THREE TRAYS)



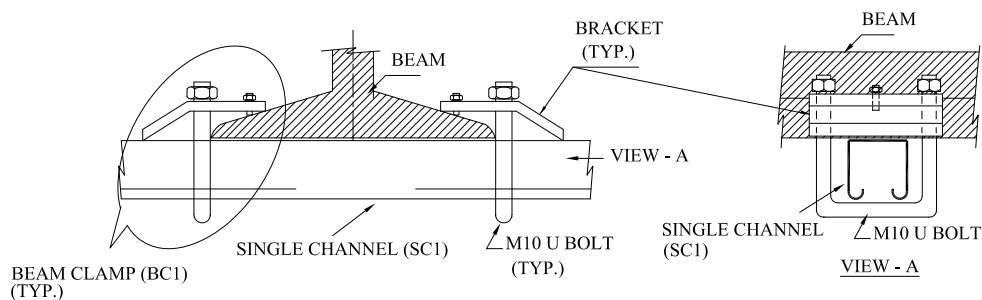
INSTALLATION DETAIL TYPE BB2:
CABLE TRAYS BELOW I-BEAMS
(MORE THAN THREE TRAYS)



INSTALLATION DETAIL TYPE BB3:
CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
UPTO & INCLUDING THREE TRAYS)



INSTALLATION DETAIL TYPE BB4:
CABLE TRAYS BELOW W. BOX/
WELDED BEAM'S (APPLICABLE FOR
MORE THAN THREE TRAYS)



SINGLE CHANNEL FIXING ARRANGEMENT WITH BEAM

CABLE TRAYS SUPPORTING ARRANGEMENT AROUND BOILER PLATFORMS

SEE GENERAL NOTES IN SHEET 17.



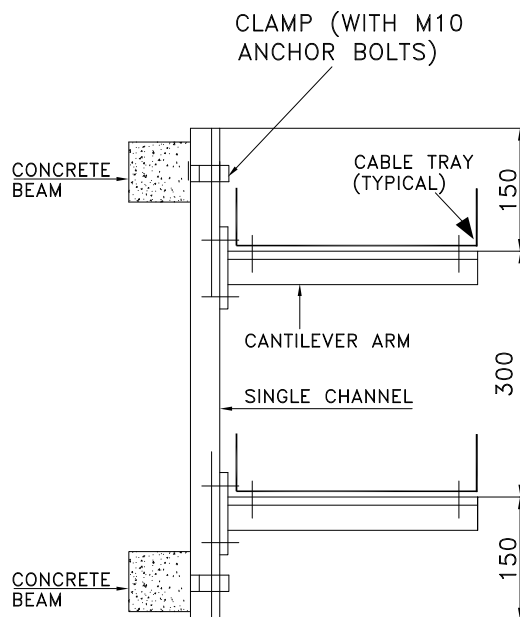
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

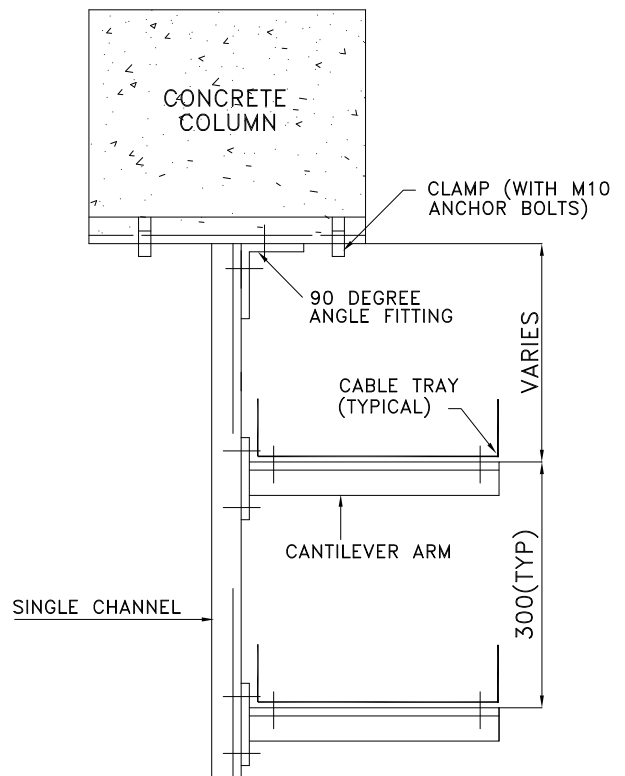
BHEL DRAWING NO.

PE-DG-435-507-E006

SH 16 OF 20



SUPPORT ARRANGEMENT
FROM CONCRETE BEAMS



SUPPORT ARRANGEMENT
FROM CONCRETE COLUMNS
WITH ANGLE FITTING

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS INDICATED OTHERWISE.
2. ALL SUPPORTS ARE OF 2.5 MM THICK MS CHANNEL SECTIONS AND GALVANISED.
3. ALL FASTENERS SHALL BE ZINC PASSIVATED/ CADMIUM PLATED.
4. ALL SUPPORT SHALL BE FIXED ON WALL / COLUMN / TRENCH BY MEANS OF 136 X 40 X 6 MM THICK CLAMP.
5. ARRANGEMENT SHOWN ARE TYPICAL ONLY.
6. ALL WELDS FOR CABLE TRAY SUPPORTS SHALL HAVE A MINIMUM THROAT THICKNESS OF 6 MM.



TITLE:

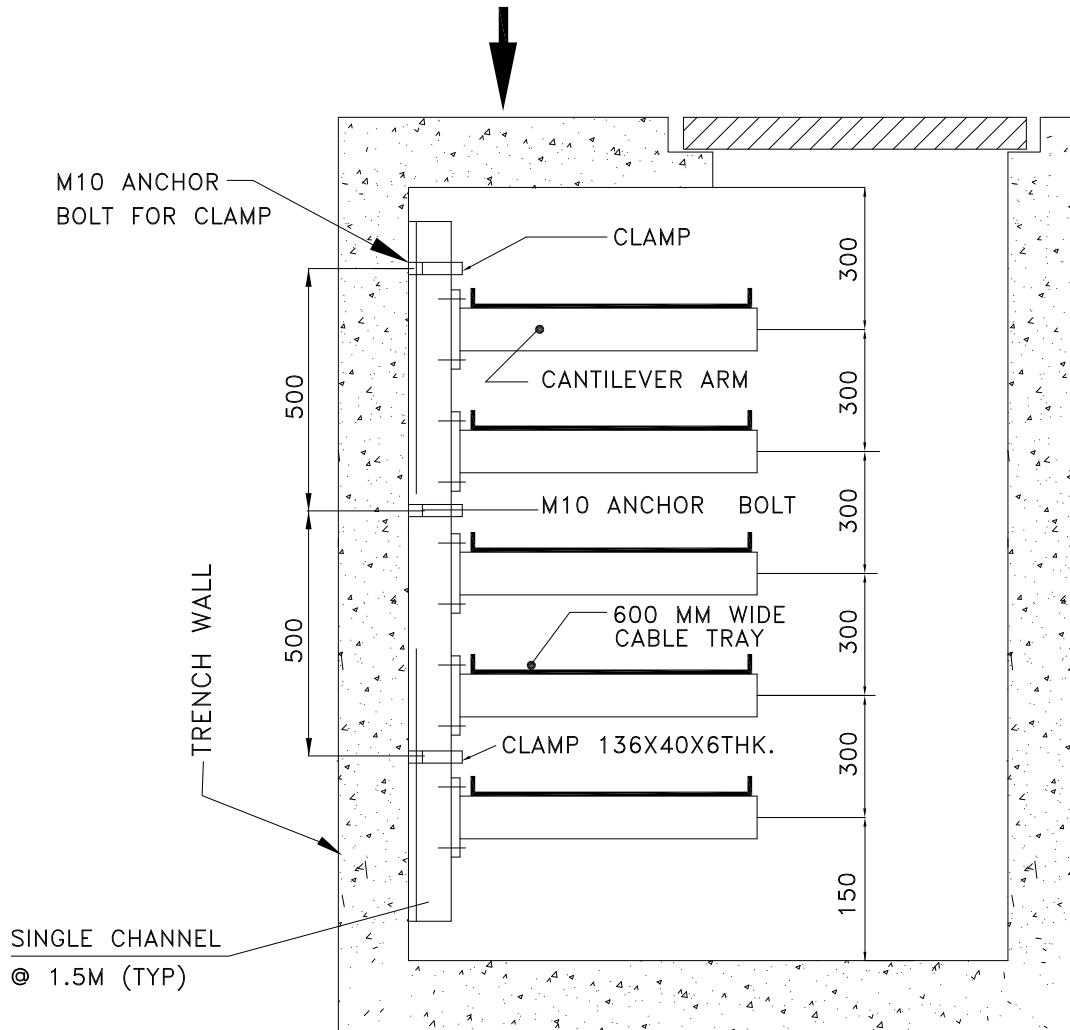
INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

BHEL DRAWING NO.

PE-DG-435-507-E006

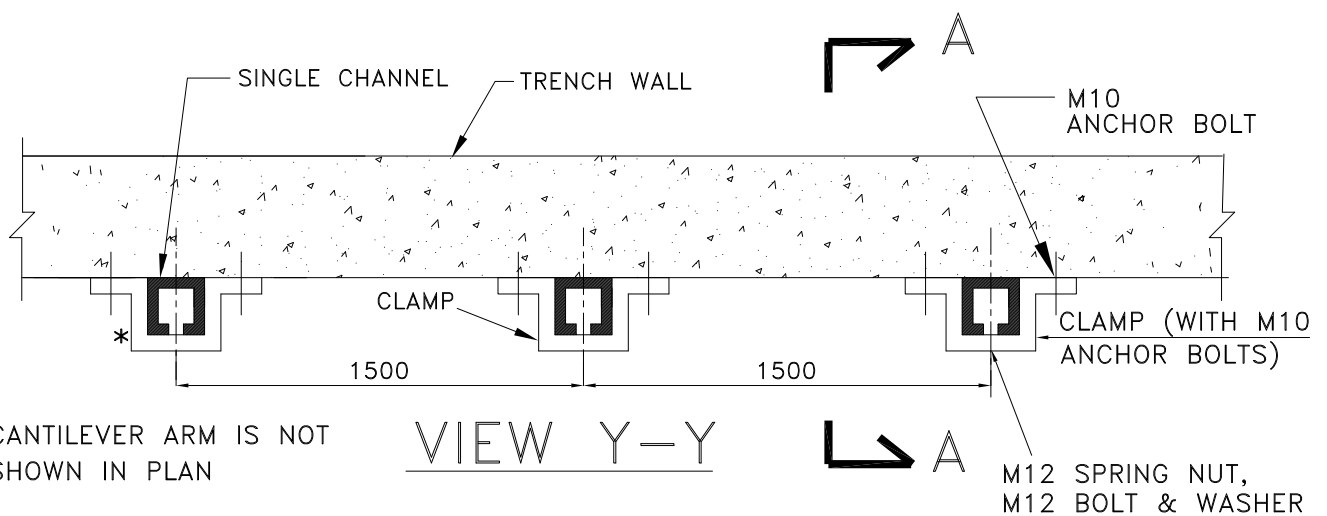
SH 17 OF 20

VIEW Y-Y



SECTION-AA

TYP. CABLE TRAYS FIXING ARRANGEMENT IN TRENCH



*CANTILEVER ARM IS NOT SHOWN IN PLAN

SEE GENERAL NOTES IN SHEET 17.



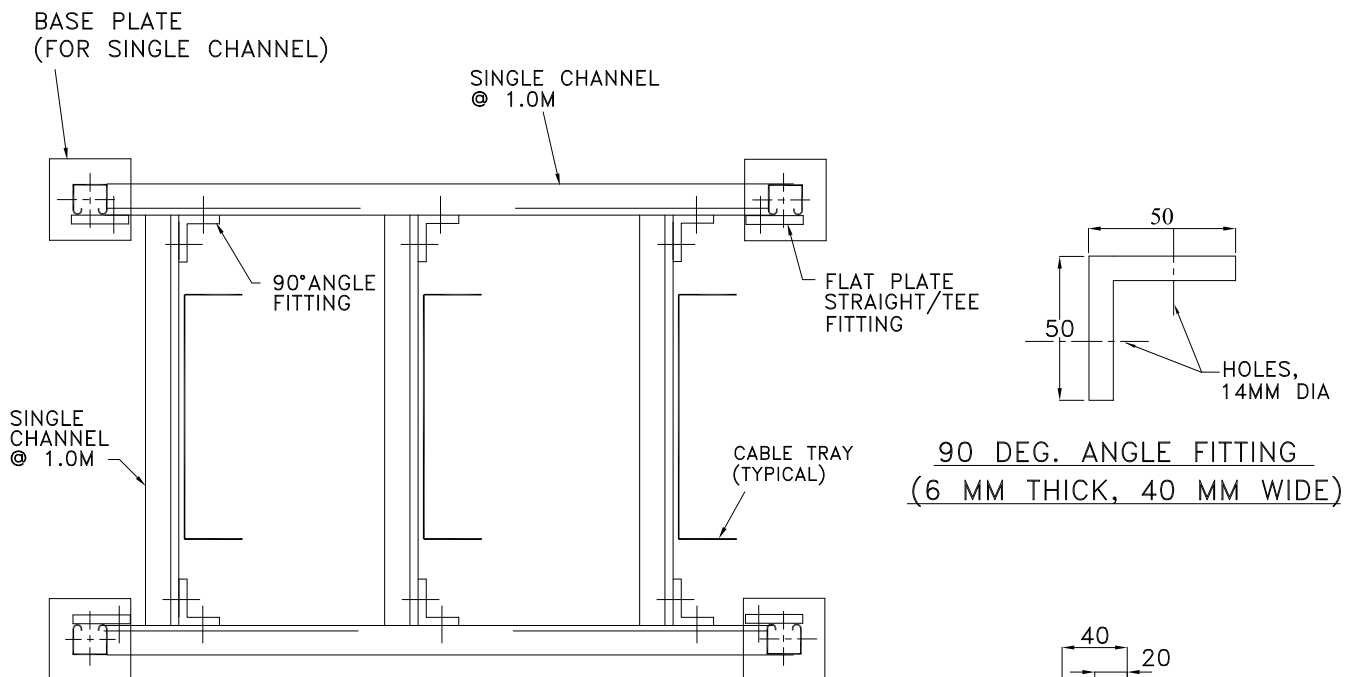
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

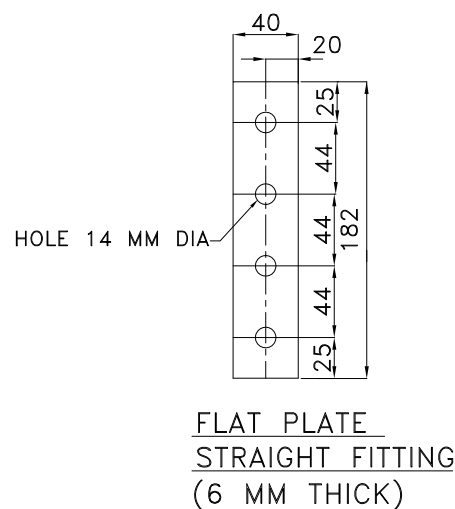
BHEL DRAWING NO.

PE-DG-435-507-E006

SH 18 OF 20

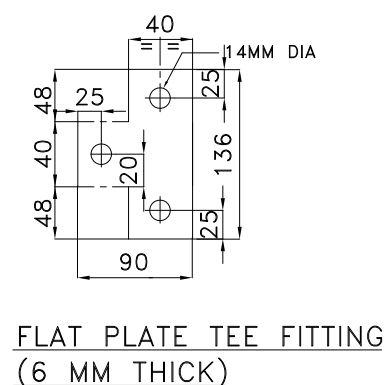


TYPICAL FLOOR SUPPORTED
CHANNEL FRAME WORK
(FOR BOLTABLE TYPE
CABLE TRAY RISER)



TYPICAL CHANNEL SUPPORT
(ON WALL)

SEE GENERAL NOTES IN SHEET 17.



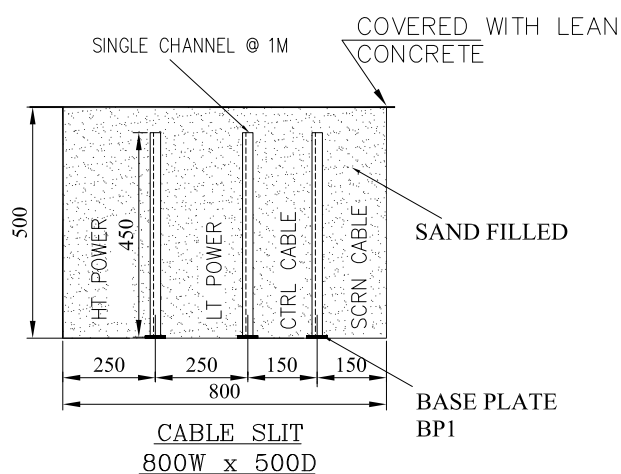
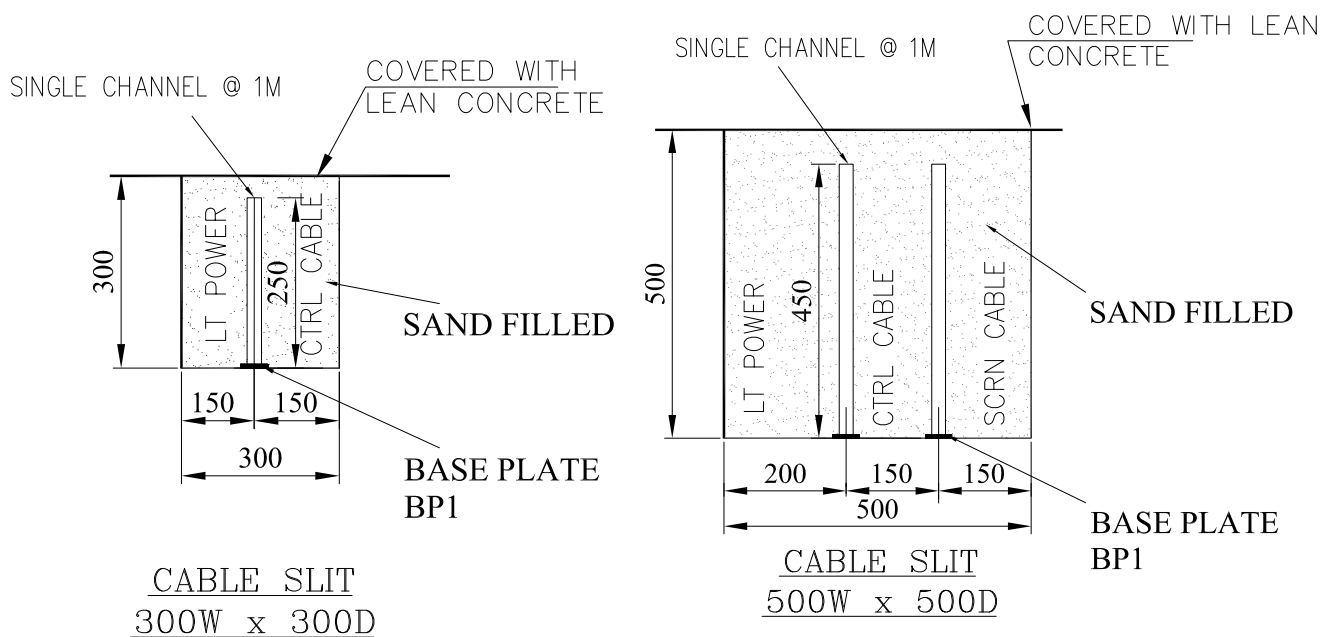
TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

BHEL DRAWING NO.

PE-DG-435-507-E006

SH 19 OF 20



TYPICAL CABLE SLIT ARRANGEMENT

SEE GENERAL NOTES IN SHEET 17.



TITLE:

INSTALLATION DETAILS FOR
CABLE TRAYS SUPPORT SYSTEM

BHEL DRAWING NO.

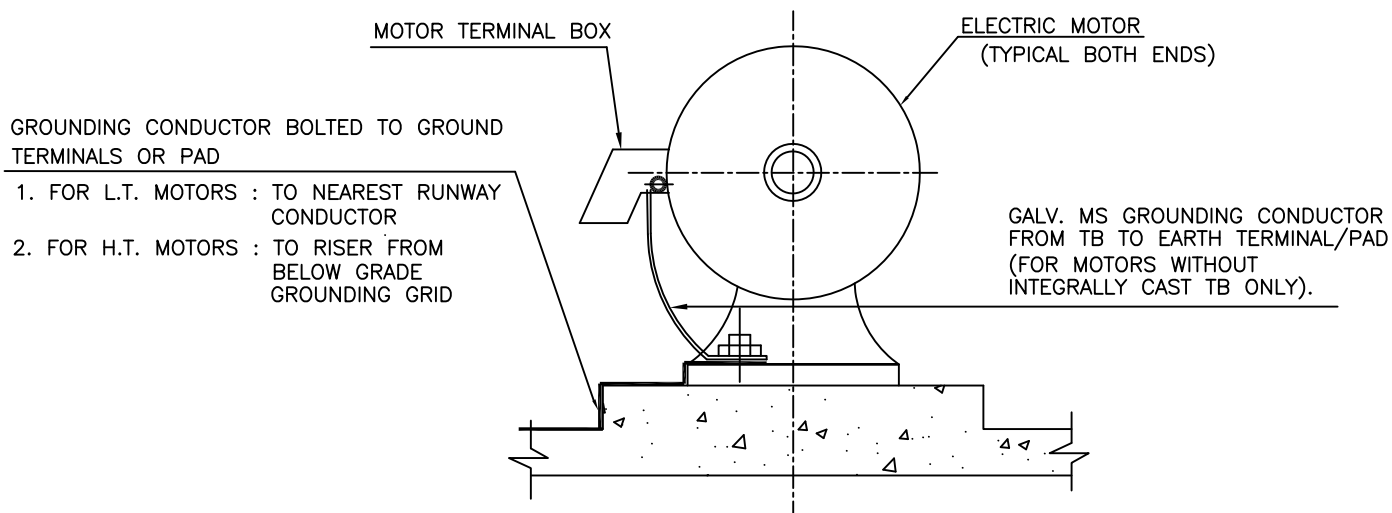
PE-DG-435-507-E006

SH 20 OF 20

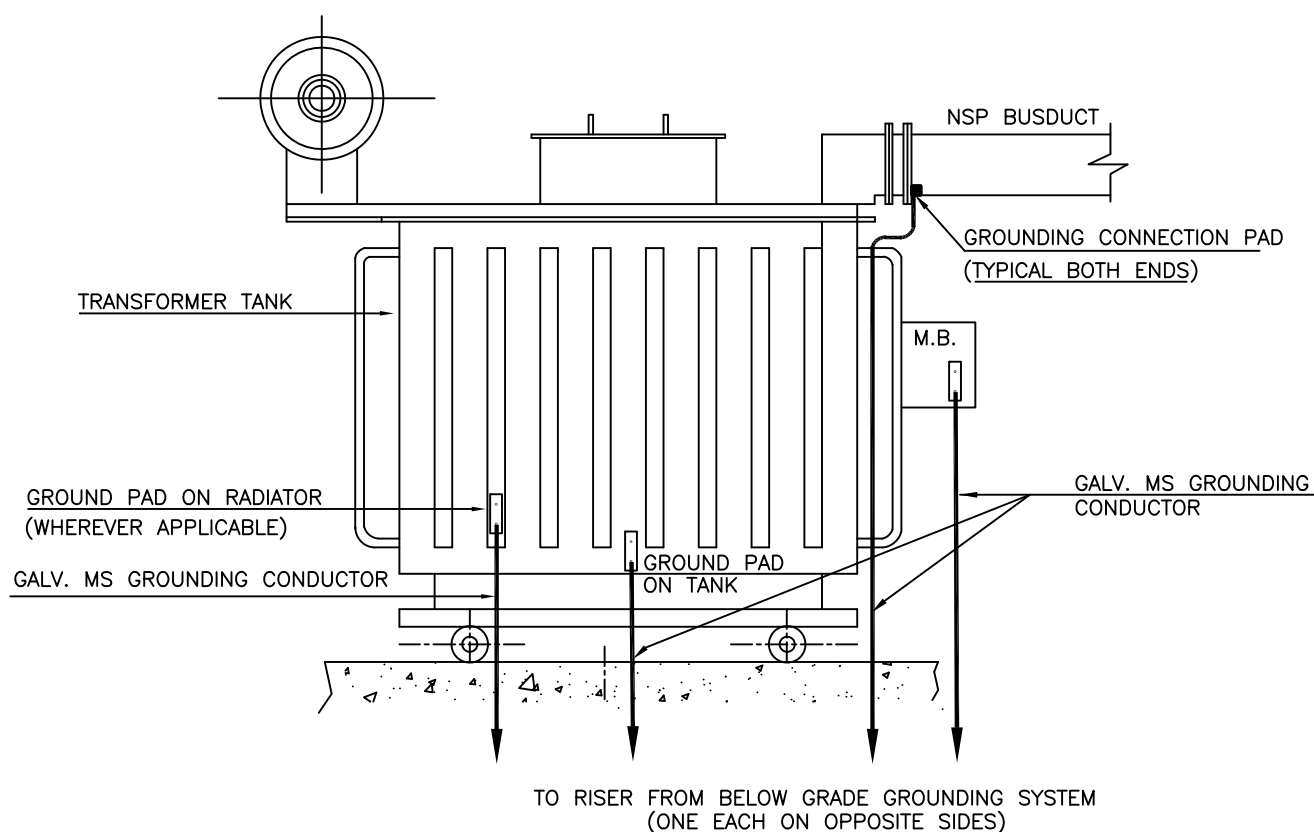
TYPICAL ABOVE GRADE

GROUNDING DETAILS

					PROJECT	2 X 660 MW UDANGUDI STPP STAGE-I							
						OWNER	TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED						
						OWNER'S CONSULTANT							
						EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA						
REV	DATE	ALTD	CHD	APPD		BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA		DEPT CODE	DRN	NAME AAT	SIGN -S.D.-	DATE	
								E	DSGN	AAT	-S.D.-	19.03.18	
									CHD	VY	-S.D.-	19.03.18	
									APPD	SL	-S.D.-	19.03.18	
					TITLE	<u>TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS</u>		DRAWING NO. PE-DG-435-509-E004					
							SHEET 1		OF 15		REV. 00		



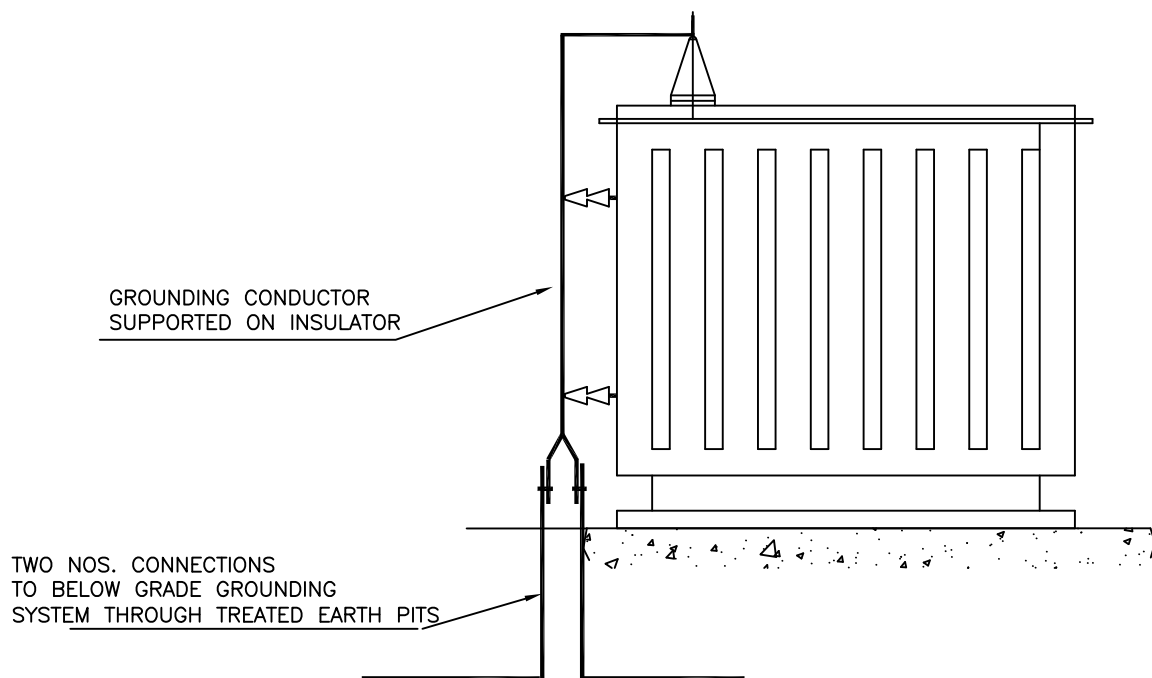
E1 : TYPICAL MOTOR GROUNDING DETAILS



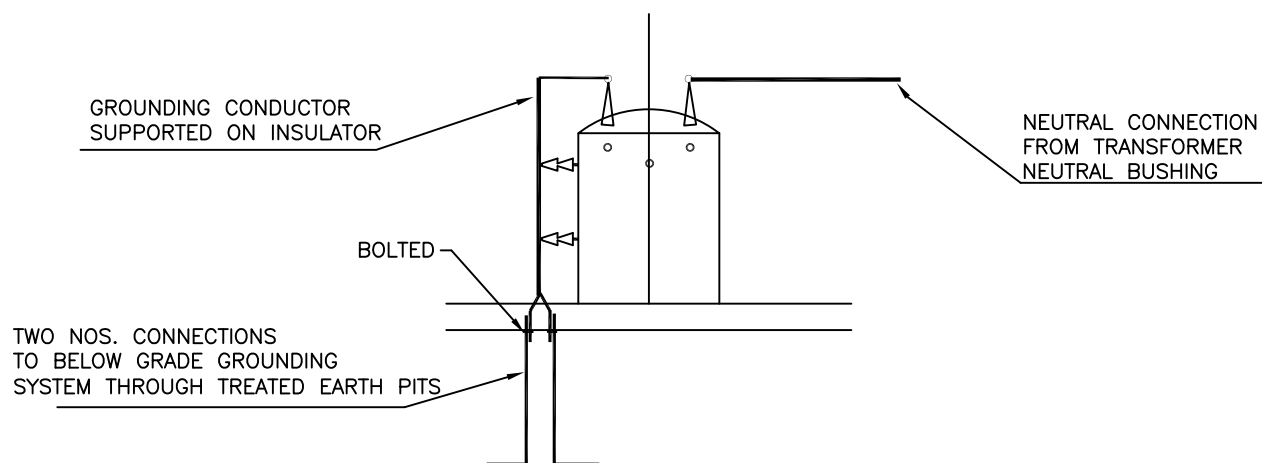
E2 : TRANSFORMER GROUNDING

FOR GENERAL NOTES REFER SHT 13

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 2 OF 15



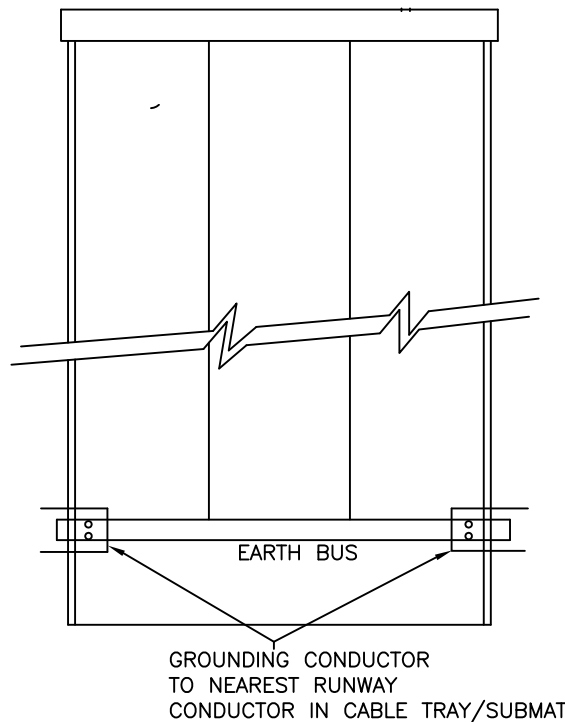
E3A : TRANSFORMER NEUTRAL EARTHING (DIRECTLY GROUNDDED)



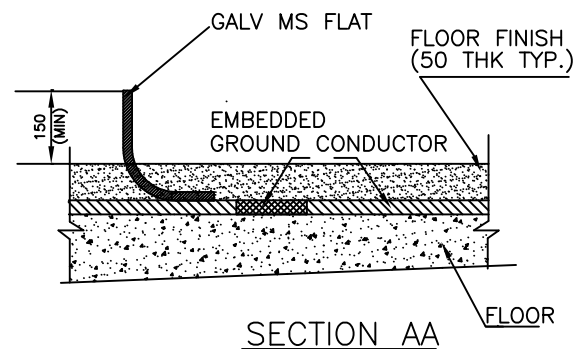
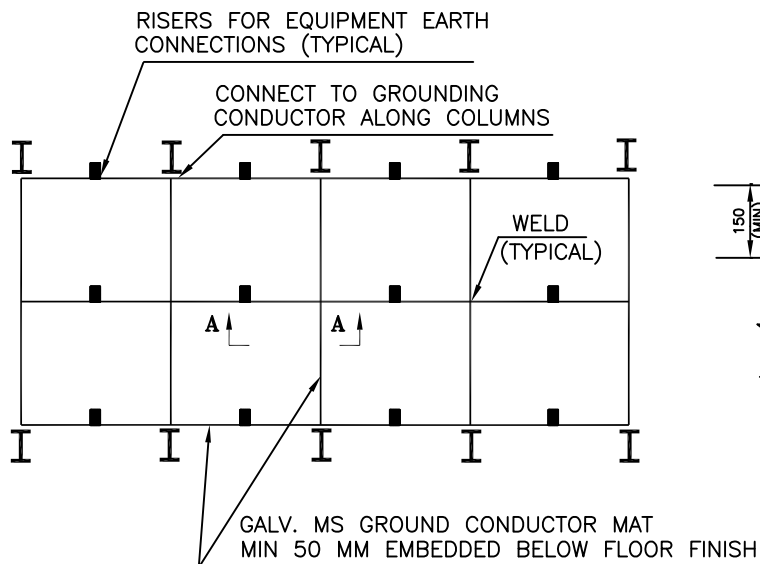
E3B : NEUTRAL EARTHING (THROUGH RESISTOR)

FOR GENERAL NOTES REFER SHT 13

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 3 OF 15



E4 : FLOOR MOUNTED PANEL GROUNDING

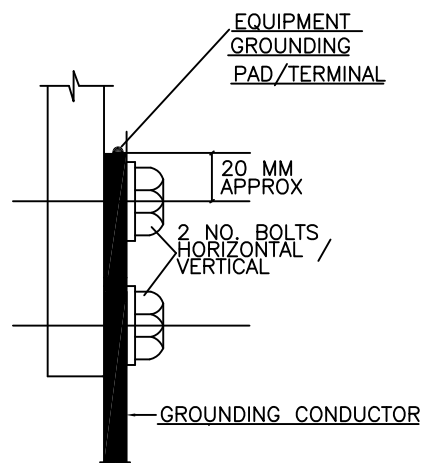


E5 : FLOOR SUBMAT TYPICAL DETAILS

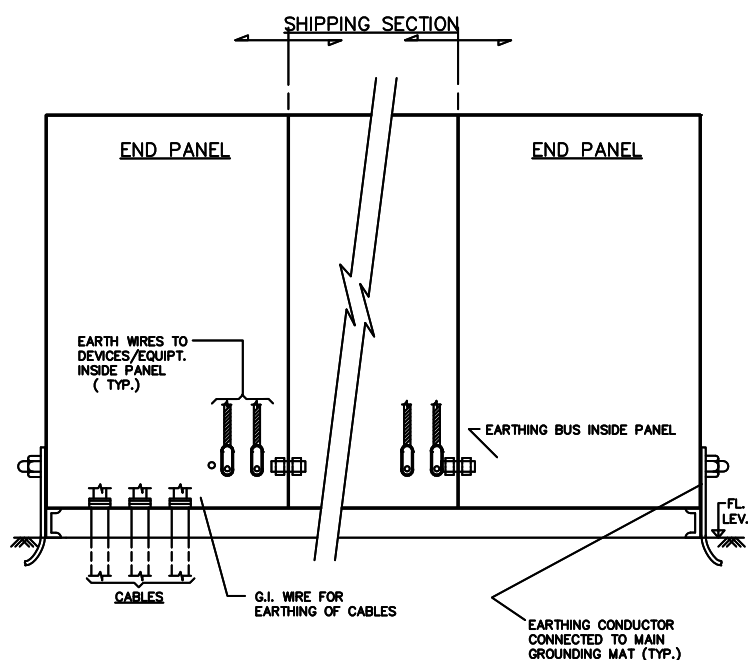
(TO BE PROVIDED ONLY IN ELECTRICAL SWGR ROOM)

FOR GENERAL NOTES REFER SHT 13

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 4 OF 15



E6 : TYPICAL ARRANGEMENT BOLTED JOINT FOR EQUIPMENT GROUNDING

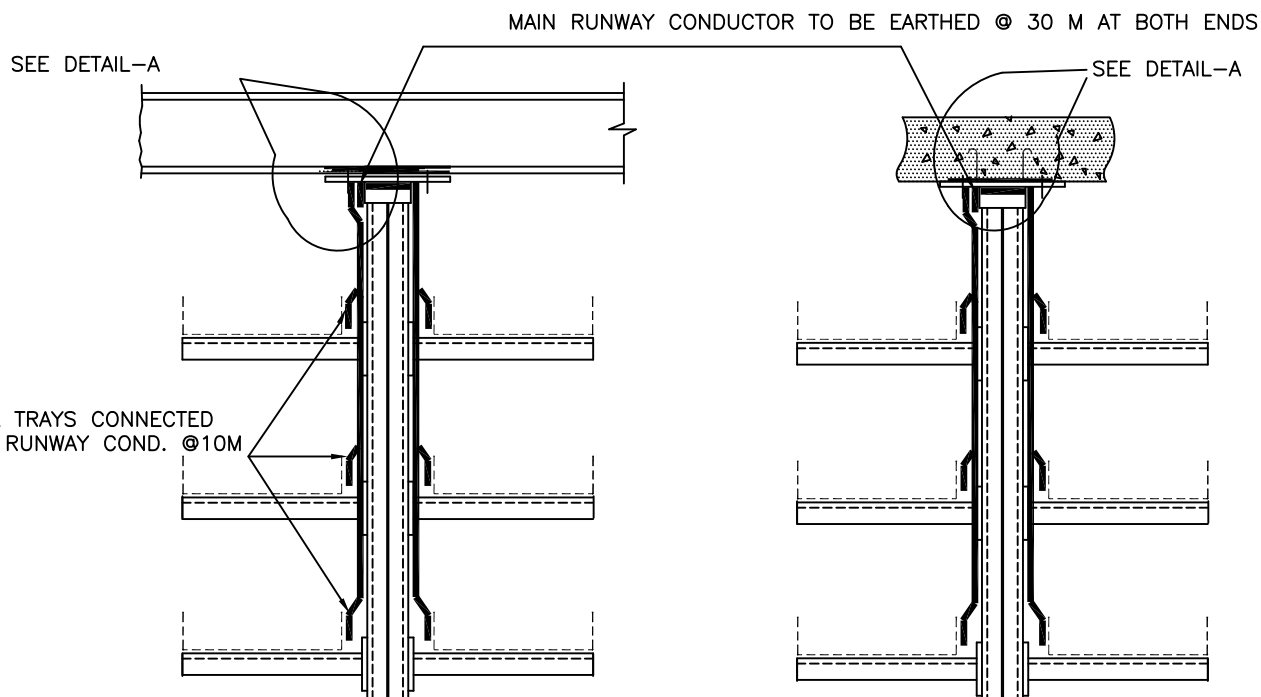


E7 : GROUNDING FOR ARMOURED CABLES

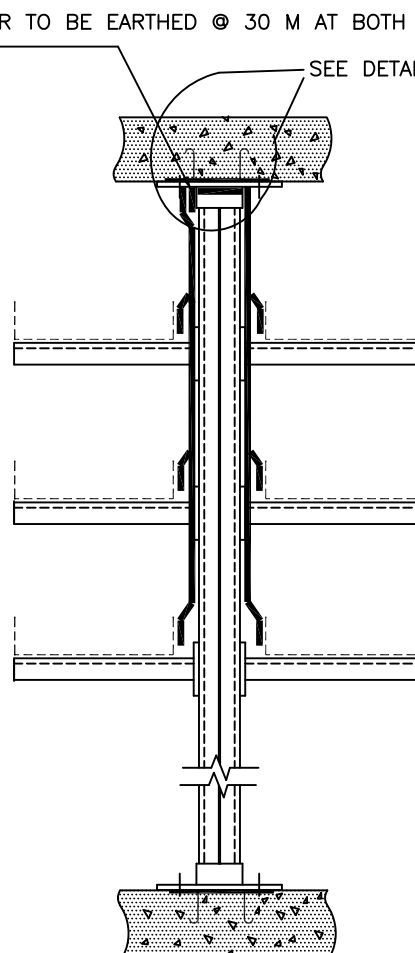
* ARMOUR OF SINGLE CORE HT & LT CABLE, GROUNDING WILL BE DONE AT ONE END ONLY

TITLE	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 5 OF 15

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

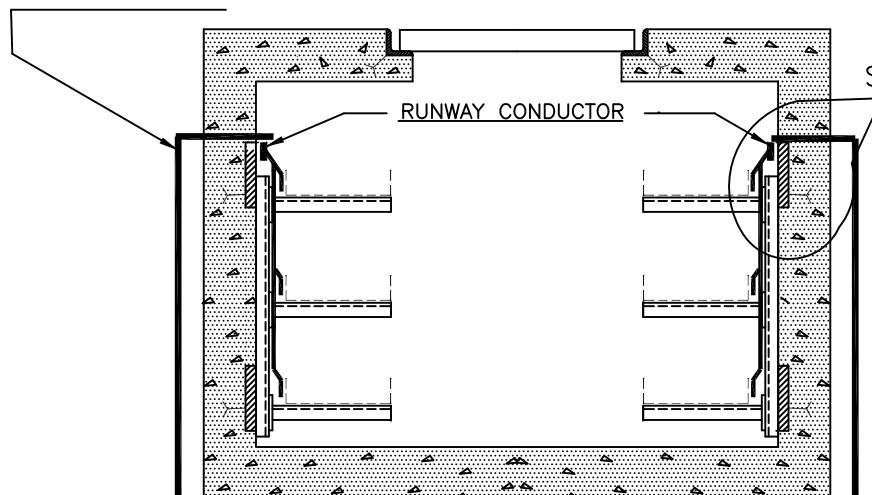


E8 : GROUNDING OF OVERHEAD TRAY STRUCTURE



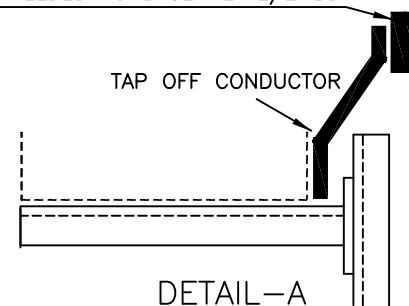
E9 : GROUNDING OF FLOOR SUPPORTED TRAY STRUCTURE

TO BELOW GRADE
GROUNDING SYSTEM



E10 : GROUNDING OF TRAYS IN CABLE TRENCH

MAIN RUNWAY CONDUCTOR
WELDED TO BASE PLATE/EMBDT.



FOR GENERAL NOTES REFER SHT 13

TITLE

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

BHEL DRAWING No.

PE-DG-435-509-E004

REV. No.

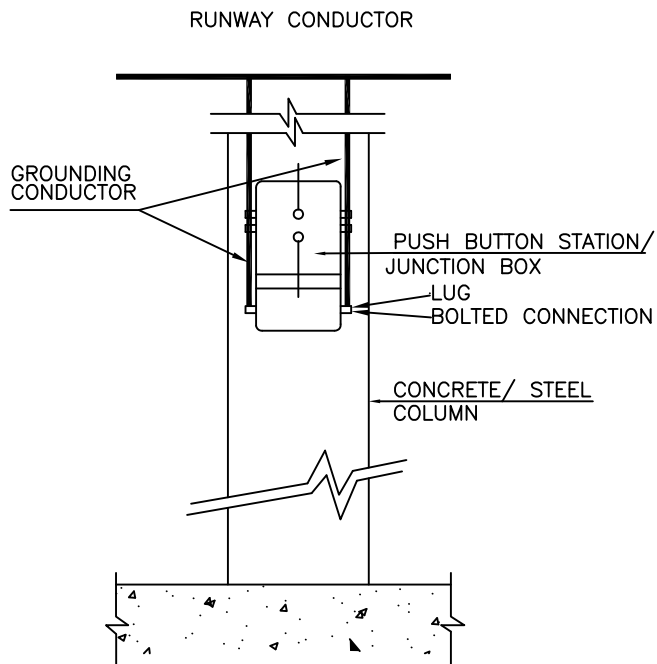
00

SHEET

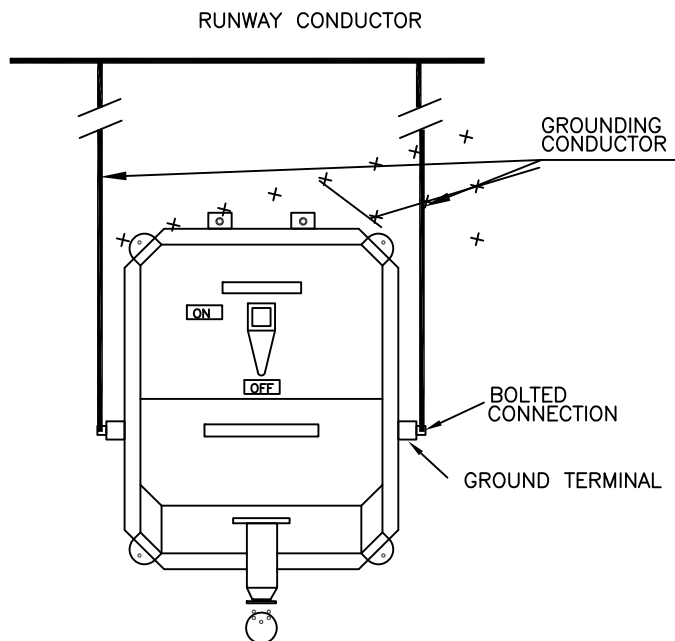
6

OF

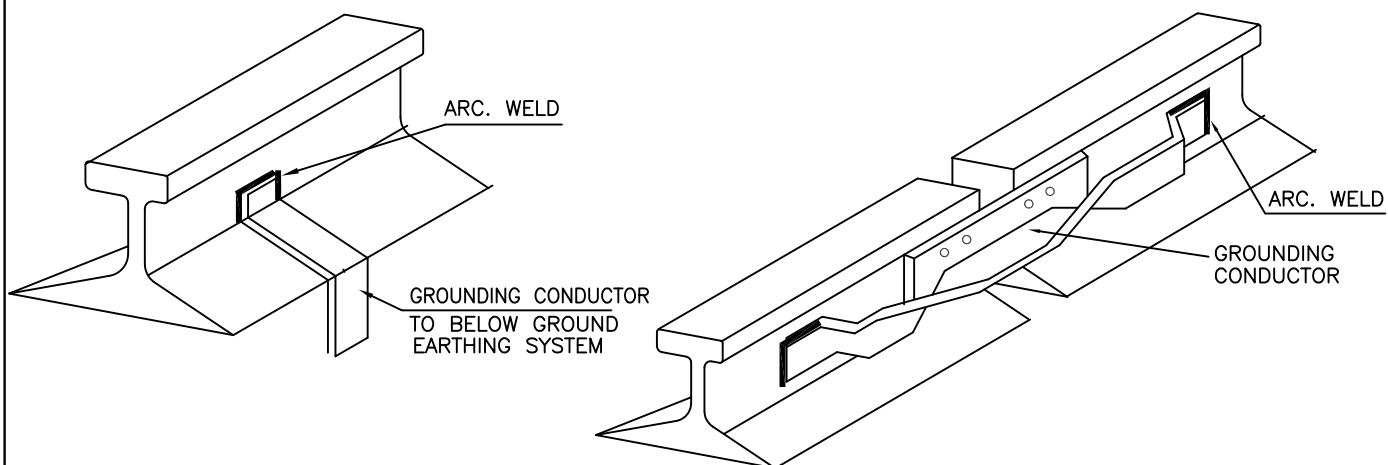
15



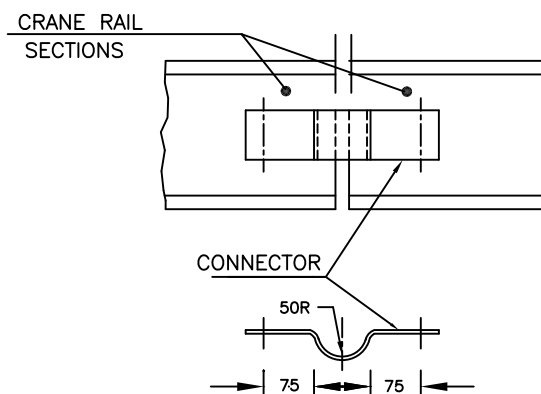
E11 : PUSH BUTTON STATION/
JUNCTION BOX GROUNDING



E12 : 3-PHASE WELDING
RECEPTACLE GROUNDING



E13 : RAIL BONDING/ GROUNDING



E14 : BONDING OF
CRANE RAIL

FOR GENERAL NOTES REFER SHT 13

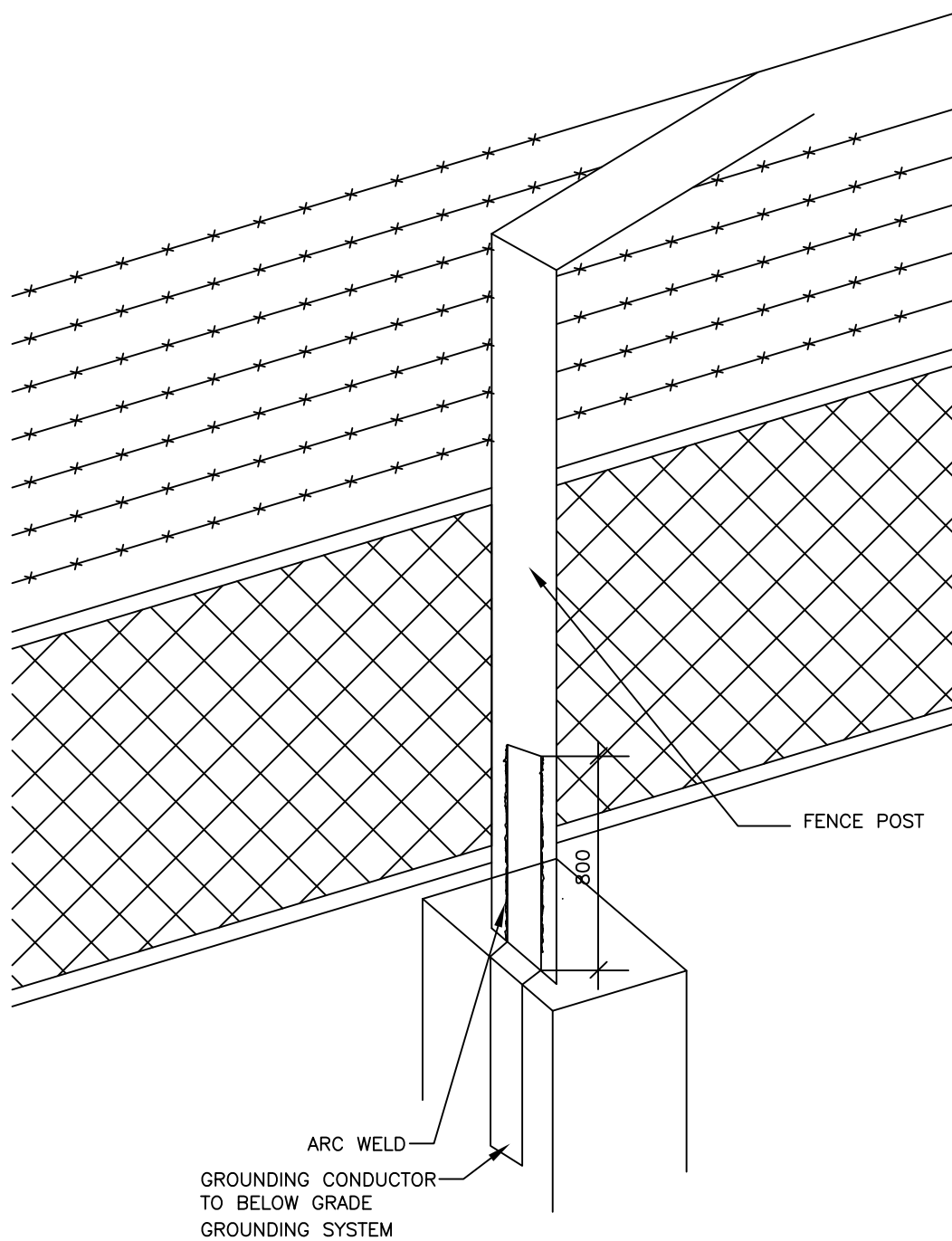
TITLE

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

BHEL DRAWING No.
PE-DG-435-509-E004

REV. No.
00

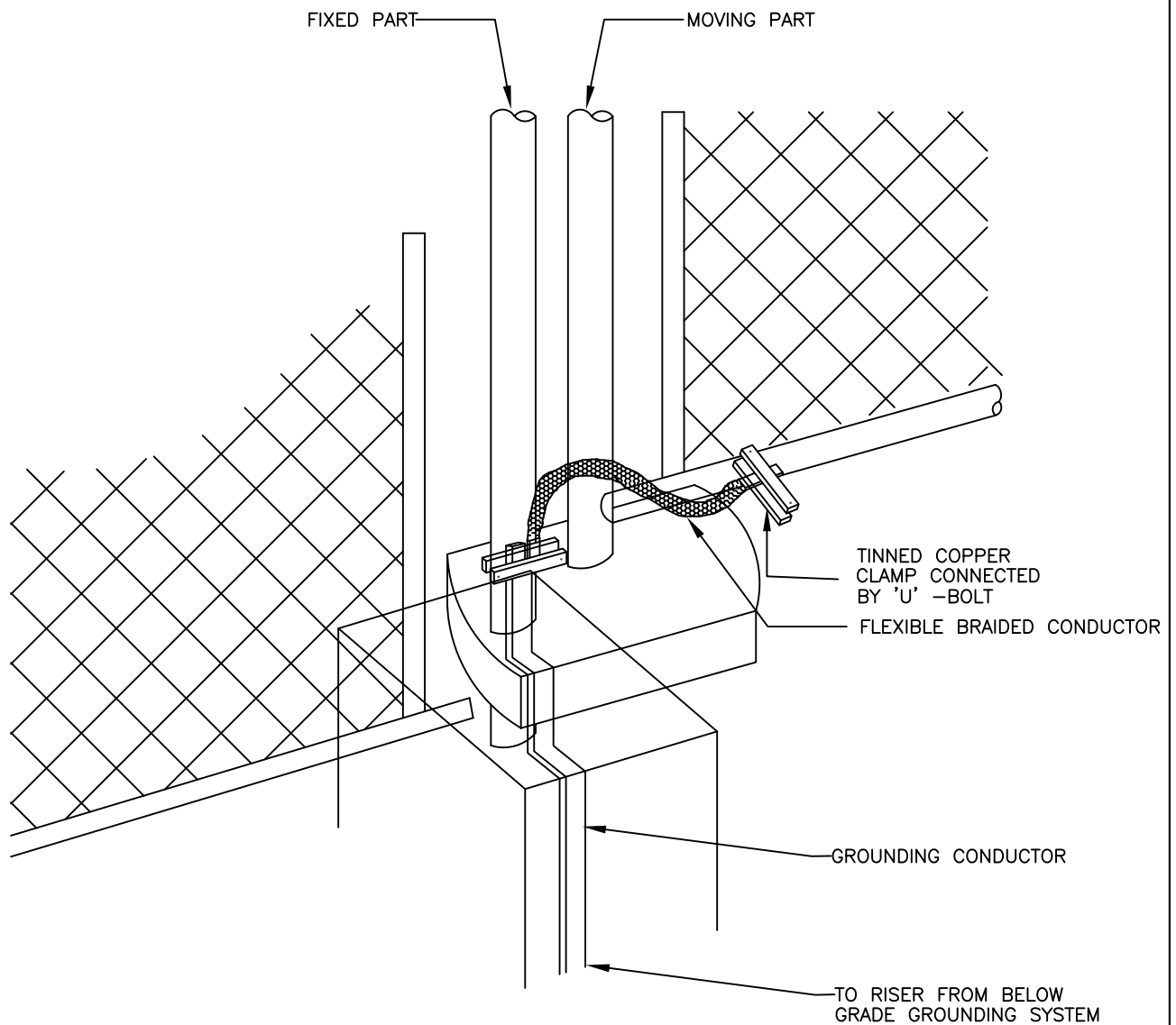
SHEET 7 OF 15



E15: FENCE GROUNDING

FOR GENERAL NOTES REFER SHT 13

TITLE	BHEL DRAWING No.
	PE-DG-435-509-E004
	REV. No.
TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	00
	SHEET 8 OF 15



E16: FENCE GATE GROUNDING

FOR GENERAL NOTES REFER SHT 13

TITLE

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

BHEL DRAWING No.

PE-DG-435-509-E004

REV. No.

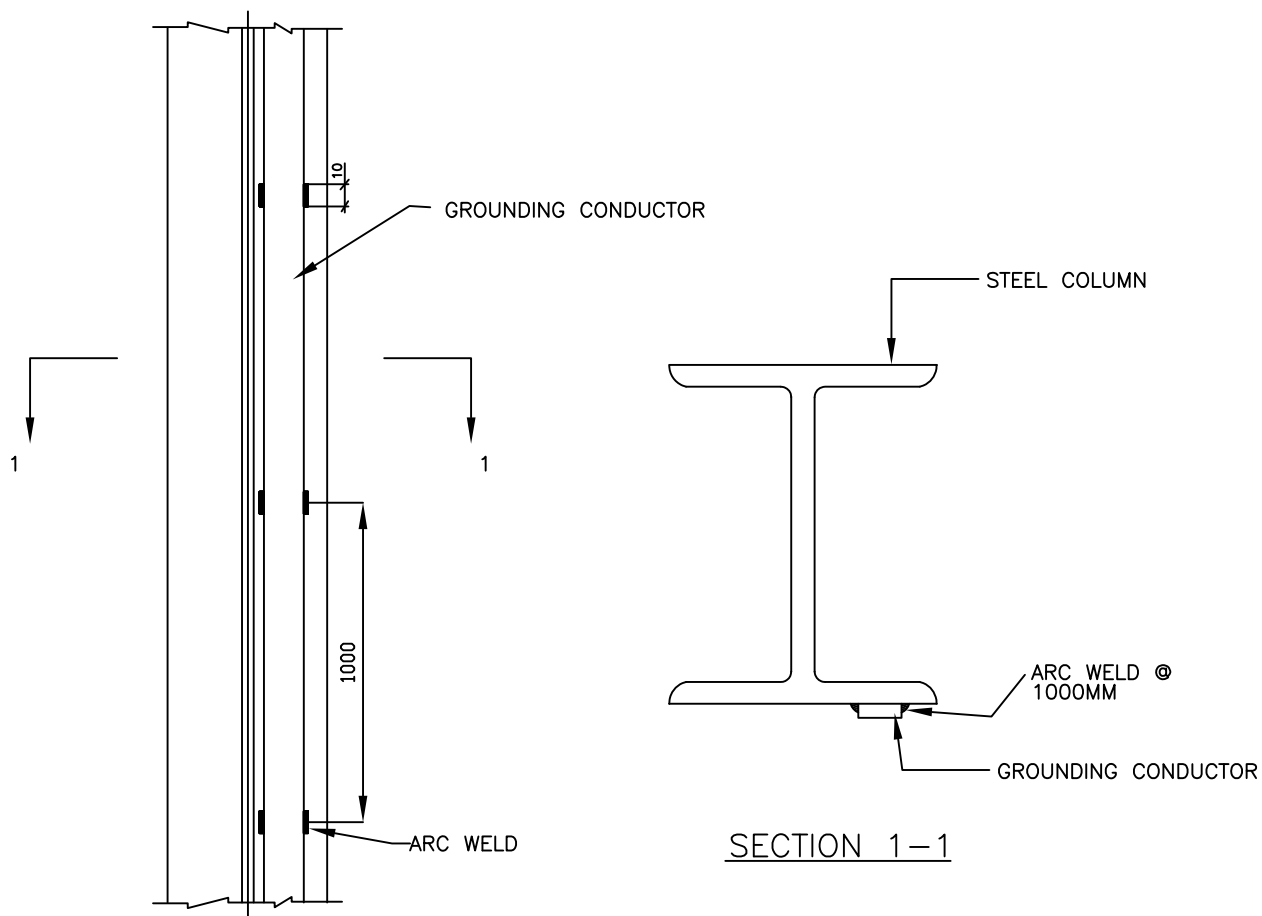
00

SHEET

9

OF

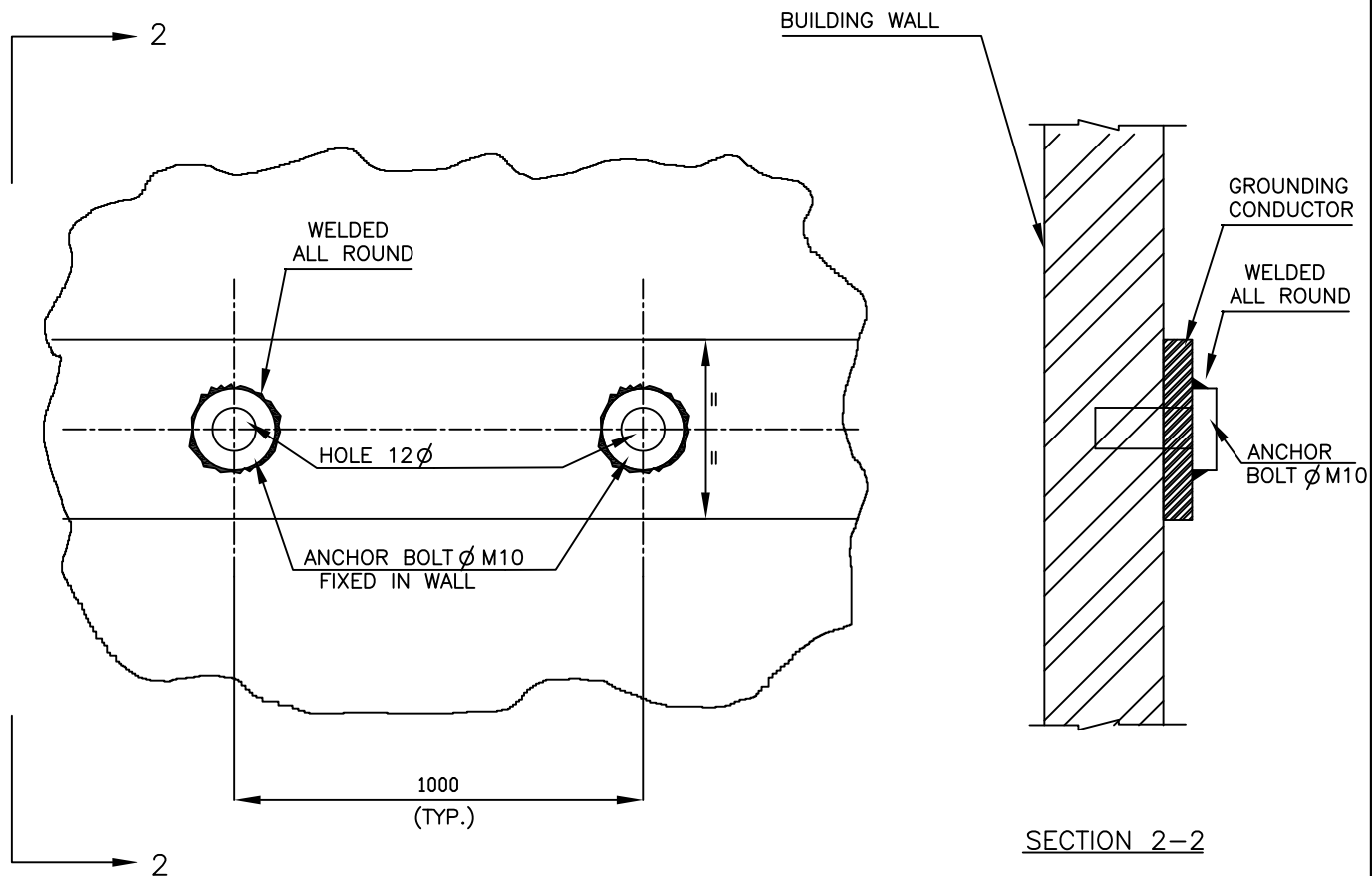
15



E17: GROUNDING CONDUCTOR
ALONG STEEL COLUMN

FOR GENERAL NOTES REFER SHT 13

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 10 OF 15



E18: GROUNDING CONDUCTOR
ALONG BUILDING WALL

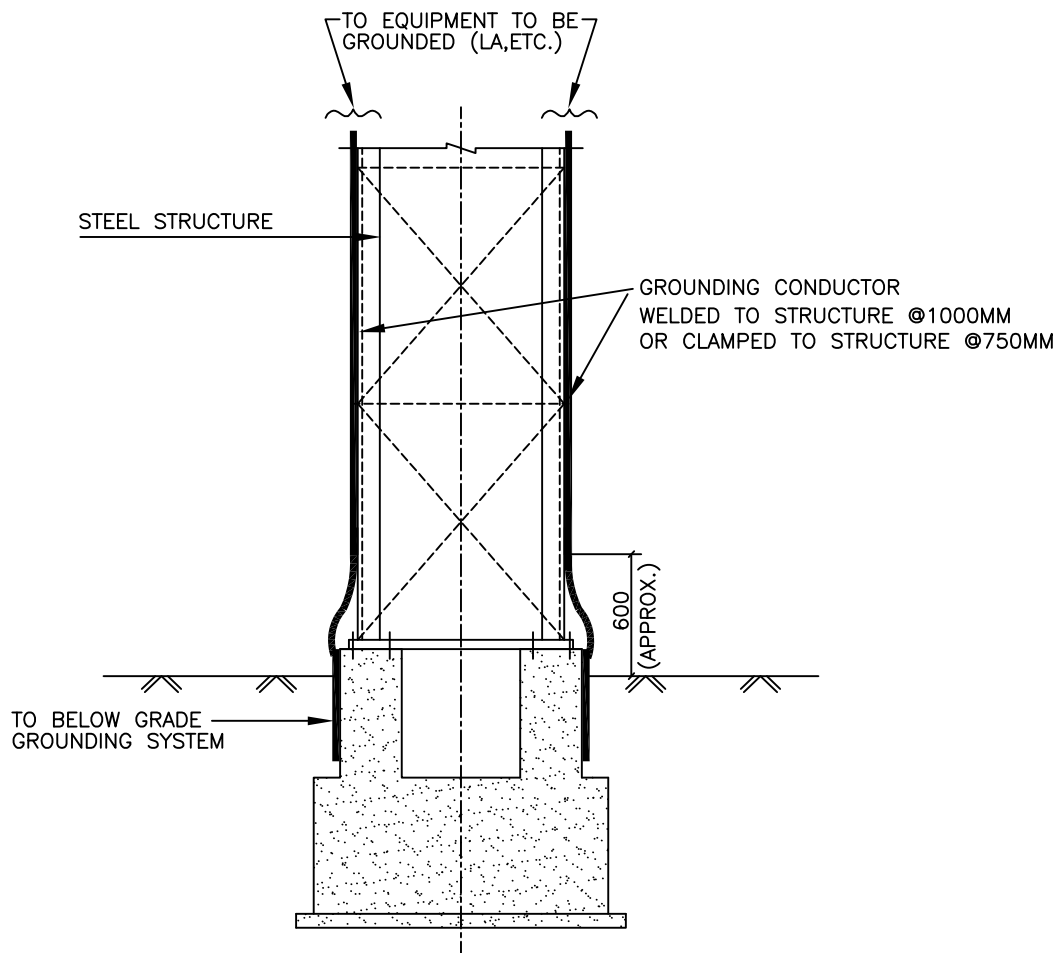
TITLE

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

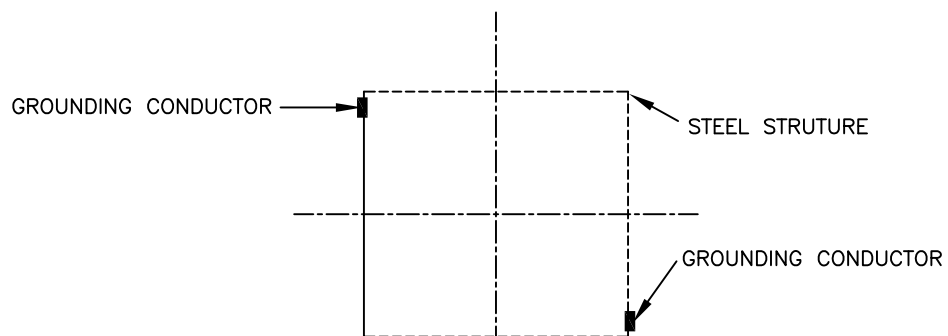
BHEL DRAWING No.
PE-DG-435-509-E004

REV. No.
00

SHEET 11 OF 15



SECTION



PLAN

STRUCTURE AND EQUIPMENT GROUNDING

TITLE

TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS

BHEL DRAWING No.

PE-DG-435-509-E004

REV. No.

00

SHEET

12

OF

15

GENERAL NOTES:

1. THE DETAILS SHOWN IN THIS DRAWING ARE APPLICABLE TO THE ABOVE GRADE LEVEL GROUNDING FOR MAIN PLANT AREA, AND AUXILIARY PLANTS IN BHEL SCOPE. FOR DETAILS OF EQUIPMENT GROUNDING IN SWITCHYARD AND FACILITIES WHICH ARE NOT IN BHEL-PEM SCOPE, SEPARATE DOCUMENTS SHALL BE REFERRED.
2. GALVANISED M.S. CONDUCTORS ARE USED FOR EQUIPMENT GROUNDING. SIZE OF GROUND CONDUCTOR SHALL BE AS PER TABLE-1 ON SHEET 15.
3. ALL GROUNDING CONDUCTOR CONNECTIONS AT EQUIPMENT ENDS ARE BOLTED.
4. ALL FASTENERS (NUTS/BOLTS/WASHERS) SHALL BE GALVANISED / ZINC PASSIVATED.
5. FROM BELOW GRADE GROUNDING SYSTEM, 65 X 8 MM GALVANISED MILD STEEL FLATS SHALL BE BROUGHT OUT FROM RISERS (40MM DIA ROD) AND CONNECTED TO MAIN GROUND CONDUCTORS (65x8 MM MS FLAT) RUN ALONG BUILDING COLUMNS/ WALLS & SECURELY FIXED TO THE SAME BY WELDING/ CLEATING AT INTERVALS OF 1000 MM. CONNECTIONS FROM EQUIPMENT GROUND TERMINALS, CABLE RACEWAYS RUNWAY CONDUCTORS, FLOOR SUBMAT, ETC. SHALL BE CONNECTED TO THESE MAIN CONDUCTORS.
6. A CONTINUOUS 50X6 MM. GALVANISED M.S. FLAT GROUND CONDUCTOR (RUNWAY CONDUCTOR) SHALL BE INSTALLED ALONG ALL CABLE RACEWAYS / RACKS, WHICH SHALL SERVE AS THE MAIN GROUNDING CONDUCTOR FOR RECEIVING INDIVIDUAL GROUND CONNECTIONS. ALL TRAY TIERS OF EACH SECTION SHALL BE CONNECTED TO THE RUNWAY CONDUCTOR AT AN INTERVAL OF ABOUT 10 M.FURTHER THIS FLAT SHALL BE EARTHED AT BOTH ENDS @ 30 M. THE RUNWAY CONDUCTORS AT DIFFERENT BUILDING ELEVATIONS SHALL BE INTERCONNECTED BETWEEN THE MAIN RISERS ALONG COLUMNS/WALLS & SHALL ALSO BE CONNECTED TO THE NEAREST RISER/ STRUCTURAL COLUMNS.
7. ALL ELECTRICAL EQUIPMENT AND ASSOCIATED NON CURRENT CARRYING METAL WORKS, SUPPORTING STRUCTURES, ETC. SHALL BE CONNECTED TO MAIN RUNWAY CONDUCTOR OR BELOW GRADE GROUNDING SYSTEM, WHERE AVAILABLE.
8. TWO SEPARATE AND DISTINCT GROUND CONNECTIONS SHALL BE PROVIDED FOR GROUNDING OF EACH ELECTRICAL EQUIPMENT FRAMEWORK.
9. ALL BUILDING STEEL COLUMNS, STRUCTURAL STEEL COLUMNS, METALLIC RAILING DEVICES SUCH AS JUNCTION BOXES, PULL BOXES, PUSH BUTTON STATIONS, LOCKOUT SWITCHES, CABLE END BOXES ETC. SHALL BE GROUNDED WHETHER SPECIFICALLY SHOWN IN THE DRAWING OR NOT.
10. GROUND CONDUCTOR CONNECTIONS ABOVE GRADE LEVEL SHALL BE GENERALLY MADE BY ELECTRIC ARC WELDING EXCEPT AT EQUIPMENT TERMINALS. RESISTANCE OF JOINTS SHALL NOT BE MORE THAN THE RESISTANCE OF EQUIVALENT LENGTH OF CONDUCTOR. M.S. GROUND CONDUCTOR ABOVE GRADE LEVEL & WELDS SHALL BE TREATED WITH ZINC CHROMATE PRIMER COATED WITH ZINC RICH PAINT TO PREVENT CORROSION. DAMAGED PORTIONS OF GALVANISED MS SHALL BE COATED WITH TWO COATS OF COLD GALVANISING AND ANTI-CORROSIVE PAINT AFTER WELDING.

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 13 OF 15

11. AT EQUIPMENT ENDS, ONLY BOLTED CONNECTION SHALL BE MADE FOR GROUNDING OF EQUIPMENT/DEVICES AND REMOVABLE STRUCTURES. THE CONTACT SURFACE SHALL BE THOROUGHLY CLEANED BEFORE CONNECTION TO ENSURE GOOD ELECTRICAL CONTACT. EQUIPMENT BOLTED CONNECTION AFTER BEING CHECKED AND TESTED SHALL BE PAINTED WITH ANTI-CORROSIVE PAINT COMPOUND.
12. EARTHING METHOD INSIDE THE SWGR ROOM SHALL BE IN THE FORM OF SUB-MAT (EARTHING GRID EMBEDDED IN THE FLOOR SLAB WITH APPROXIMATELY 50 MM OF CONCRETE COVER) OF GALVANIZED CONDUCTOR OF 50X6 MM . FURTHER IN CASE OF BUILDINGS HAVING MORE THAN ONE FLOOR, SWGR ROOM OF EACH FLOOR SHALL BE PROVIDED WITH SEPARATE EARTH GRID. THESE FLOOR EARTH GRIDS SHALL BE INTERCONNECTED. THIS SUB-MAT IS CONNECTED TO THE BELOW GRADE GROUNDING SYSTEM AT MINIMUM TWO POINTS THROUGH GALVANIZED FLATS. BEFORE FLOOR FINISHING IS DONE AND CONNECTED TO THE BELOW GROUND EARTHING SYSTEM THROUGH TWO RISERS LOCATED PREFERABLY DIAMETRICALLY OPPOSITE TO EACH OTHER, SUITABLE RISER STUBS SHALL BE PROVIDED ABOVE THE FINISHED FLOOR IF THE EQUIPMENT IS NOT AVAILABLE AT THE TIME OF LAYING THE MAIN GROUNDING CONDUCTOR.
13. GROUNDING INSTALLATION SHALL CONFORM TO THE FOLLOWING:
- (A) IS:3043
 - (B) INDIAN ELECTRICITY RULES
 - (C) BHEL DOCUMENT NO. PE-DC-435-509-E002 (GROUNDING SYSTEM DESIGN MEMORANDUM)

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 14 OF 15

TABLE-1

MATERIAL AND SIZES OF ABOVE GROUND EARTHING SYSTEM

SL.NO.	TYPE OF EQUIPMENT	SIZE (MM)	MATERIAL	NO. OF LEADS
1	INTERCONNECTION BETWEEN RISER AND STEEL COLUMN & ALONG COLUMNS	65X 8	GALVANISED MS FLAT	N.A.
2	SUB-MAT BURIED IN FLOOR FINISH	50X 6	GALVANISED MS FLAT	N.A.
3	RUNWAY CONDUCTOR	50X 6	GALVANISED MS FLAT	N.A.
4	11 kV / 3.3 kV SWITCHGEAR / BUSDUCT	65X 8	GALVANISED MS FLAT	TWO
5	LT TRANSFORMER (ENCLOSURE & NEUTRAL)	75X 8	GALVANISED MS FLAT	TWO
6	415 V DISTRIBUTION BOARDS , LT BUSDUCT	75X 8	GALVANISED MS FLAT	ONE FOR EACH SECTION
7	DG SET & FUSE DISTRIBUTION BOARDS	50X 6	GALVANISED MS FLAT	TWO
8	11 kV & 3.3 kV MOTORS	50X6	GALVANISED MS FLAT	TWO
9	415 V MOTORS: ABOVE 75 KW	50X 6	GALVANISED MS FLAT	TWO
10	415 V MOTORS: ABOVE 30 KW & UPTO 75KW	32X5	GALVAN IS ED MS FLAT	TWO
11	415 V MOTORS: 9.3 KW UPTO 30 KW	25X3	GALVANISED MS FLAT	TWO
12	415 V MOTORS: BELOW 5.5, 5.5,7.5 kW	6/4/4 SWG	GI WIRE	TWO
13	CONTROL PANEL & CONTROL DESK	25X3	GALVANISED MS FLAT	TWO
14	PUSH BUTTON STATION & JUNCTION BOX	14 SWG	GI WIRE	TWO
15	RELAY PANEL	25X6	GALV MS FLAT	
16	CHARGER/UPS/ CT/PT JUNCTION BOX	50X 6	GALVANISED MS FLAT	TWO
17	LIGHTING/ CONTROL JUNCTION BOX	8 SWG	GI WIRE	TWO
18	RAILS & METAL PARTS, FENCE	25X6	GALVANISED MS FLAT	ONE
19	HT TRANSFORMER (ENCLOSURE & NEUTRAL)	65X8	GALVANISED MS FLAT	TWO
20	GENERATOR , LAPT,NGT, NGT NEUTRAL	50X6	GALVANISED MS FLAT	TWO
21	WELDING OUTLETS 3-PHASE RECEPTACLES	25X6	GALVANISED MS FLAT	TWO
22	LIGHTING DISTRIBUTION BOARD, LIGHTING PANELS	50X 6	GALVANISED MS FLAT	TWO
23	LIGHTING POLES/ LIGHTING MASTS	25X6 *	GALVANISED MS FLAT	ONE
24	FIXTURES & SOCKETS	8 SWG	GI WIRE	ONE

* 20 DIA ROD FOR BELOW GROUND EARTHING

TITLE TYPICAL ABOVE GRADE LEVEL GROUNDING DETAILS	BHEL DRAWING No. PE-DG-435-509-E004
	REV. No. 00
	SHEET 15 OF 15

TYPICAL LIGHTNING PROTECTION DETAILS

										PROJECT	2X660MW UDANGUDI STPP,STAGE-I										
											CUSTOMER	TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED									
											EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA									
REV	DATE	DRN	CHD	APPD	REV	DATE	DRN	CHD	APPD	DOCUMENT TITLE:			DPT CODE-E		NAME	SIGN	DATE				
										TYPICAL LIGHTNING PROTECTION DETAILS				DSN	AAT	-SD-	09.04.18				
														CHD	YY	-SD-	09.04.18				
																APP	SL	-SD-	09.04.18		
										DOCUMENT NO:			PE-DG-435-509-E006								
																		REV. 00			

CONTENT SHEET

SL. NO.	DESCRIPTION	SHEET NO.
1.	TYPICAL FIXING/CONNECTION DETAILS OF VERTICAL AIR TERMINAL ROD ON THE ROOF OF BUILDING	3
2.	TYPICAL DETAILS OF CLAMPING HORIZONTAL AIR TERMINATION CLAMPING OVER ROOF	4
3.	TYPICAL DETAILS OF DOWNCONDUCTOR FIXING AND TEST LINK	5
4.	TYPICAL DETAILS OF CONNECTION AMONG HORIZONTAL AIR TERMINAL, DOWN CONDUCTOR AND RISER	6
5.	TYPICAL DETAILS OF CONNECTION AMONG HORIZONTAL AIR TERMINAL, DOWN CONDUCTOR FOR 'A' ROW CLADDING	7
6.	NOTES	8 & 9

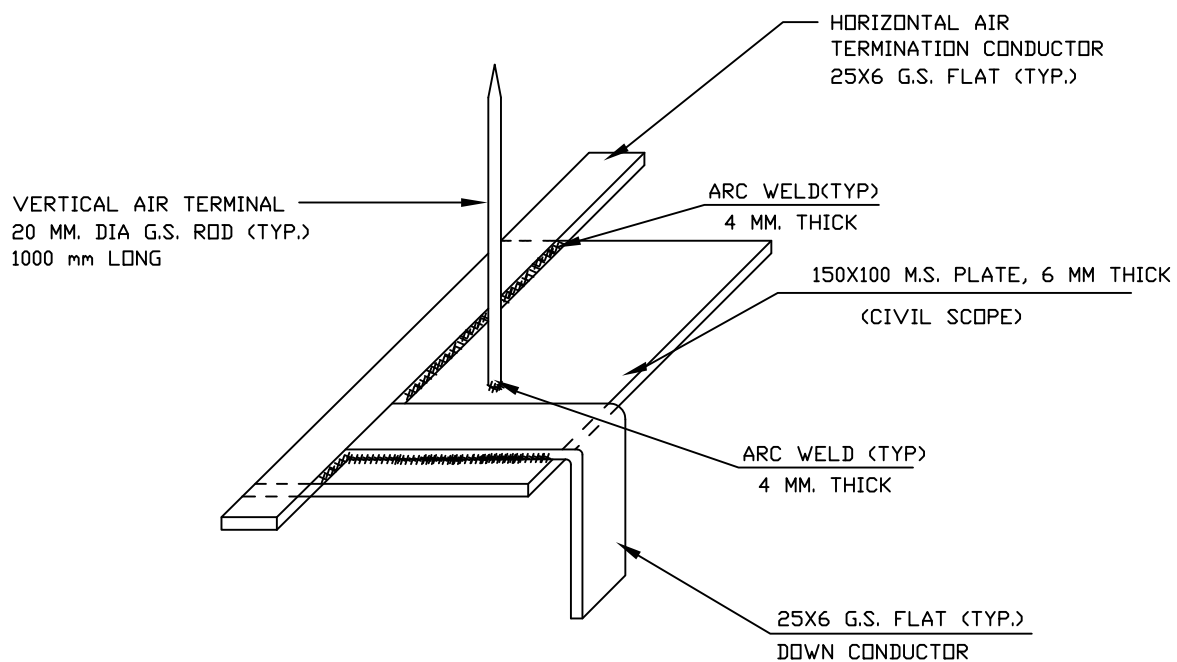
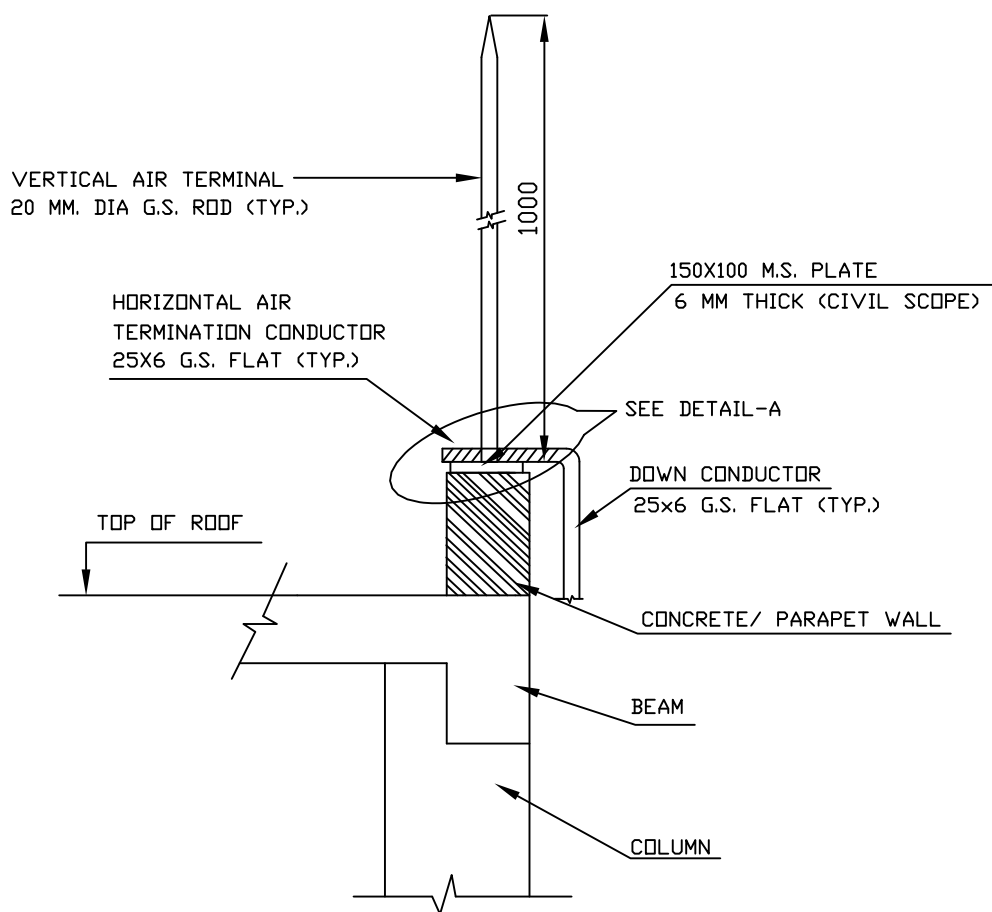
TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 2 OF 9



DETAIL-A

TYPICAL FIXING/CONNECTION DETAILS OF VERTICAL AIR TERMINAL ROD
ON THE ROOF OF BUILDING

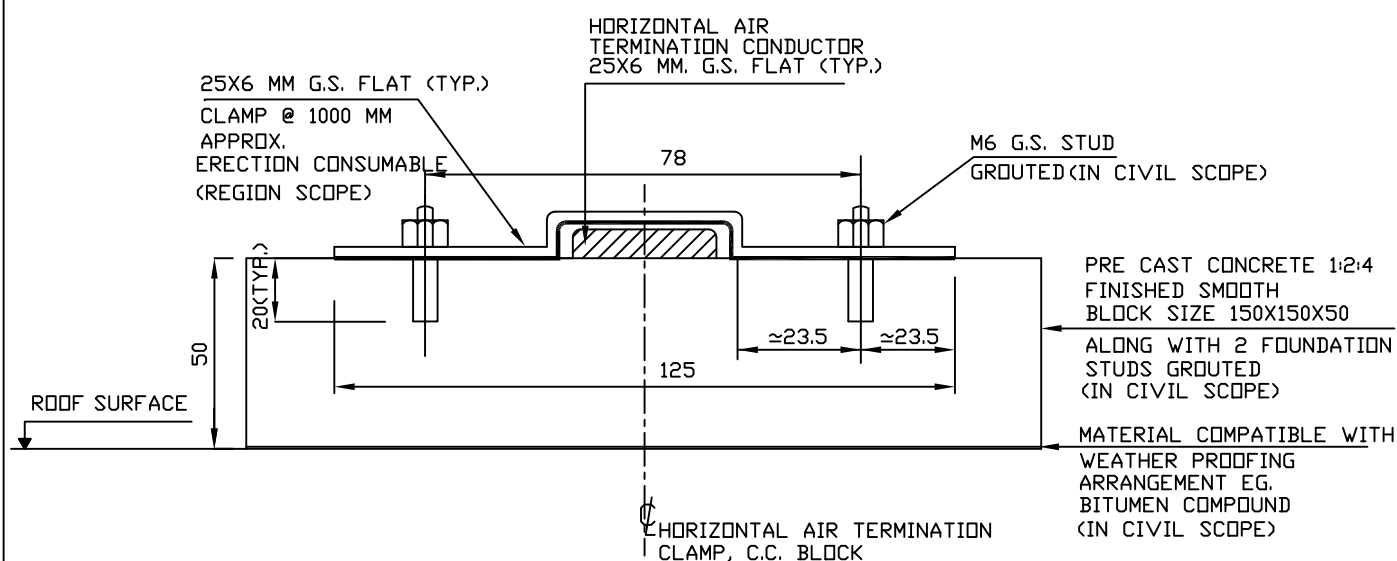
TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

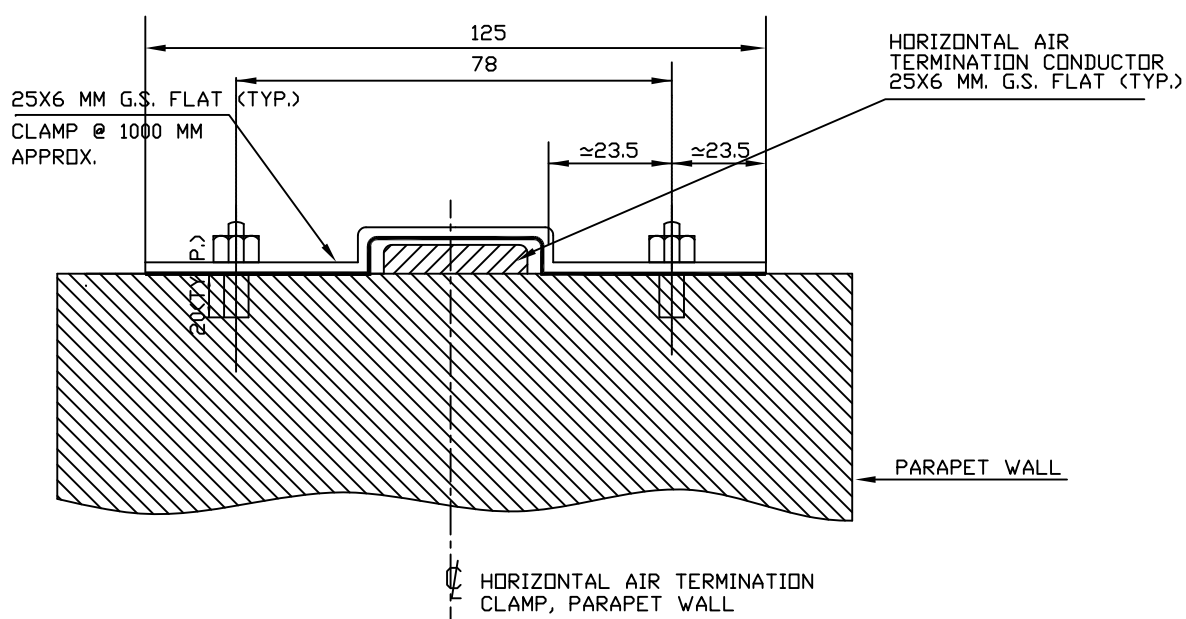
BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 3 OF 9



(A) OVER ROOF SURFACE



(B) OVER PARAPET WALL

TYPICAL DETAILS OF CLAMPING HORIZONTAL AIR TERMINATION
CLAMPING OVER ROOF

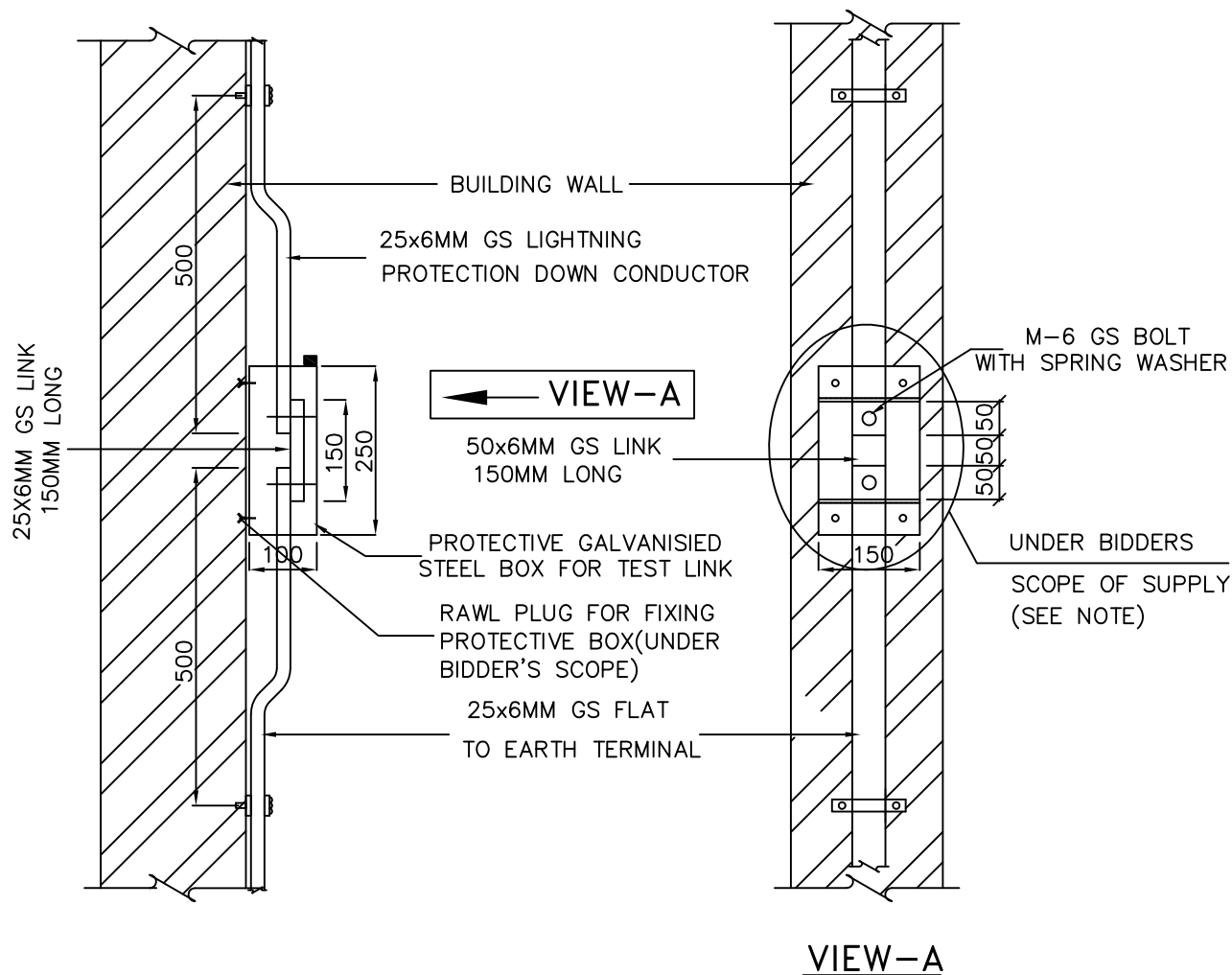
TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 4 OF 9



NOTE: BIDDER'S SCOPE INCLUDES THE 150 MM LONG 50X6MM GS LINK ALONG WITH HARDWARES (2 NOS. OF M-6 GS NUTS & BOLTS & 4 NOS. SPRING WASHERS) & 250X150X100 MM GALVANISED MS COVERING BOX (1.6 MM THICK) WITH 4 NOS. M12 SCREWS & RAWL PLUGS FOR FIXING OF THE SAME.

TYPICAL DETAILS OF DOWNCONDUCTOR
FIXING AND TEST LINK

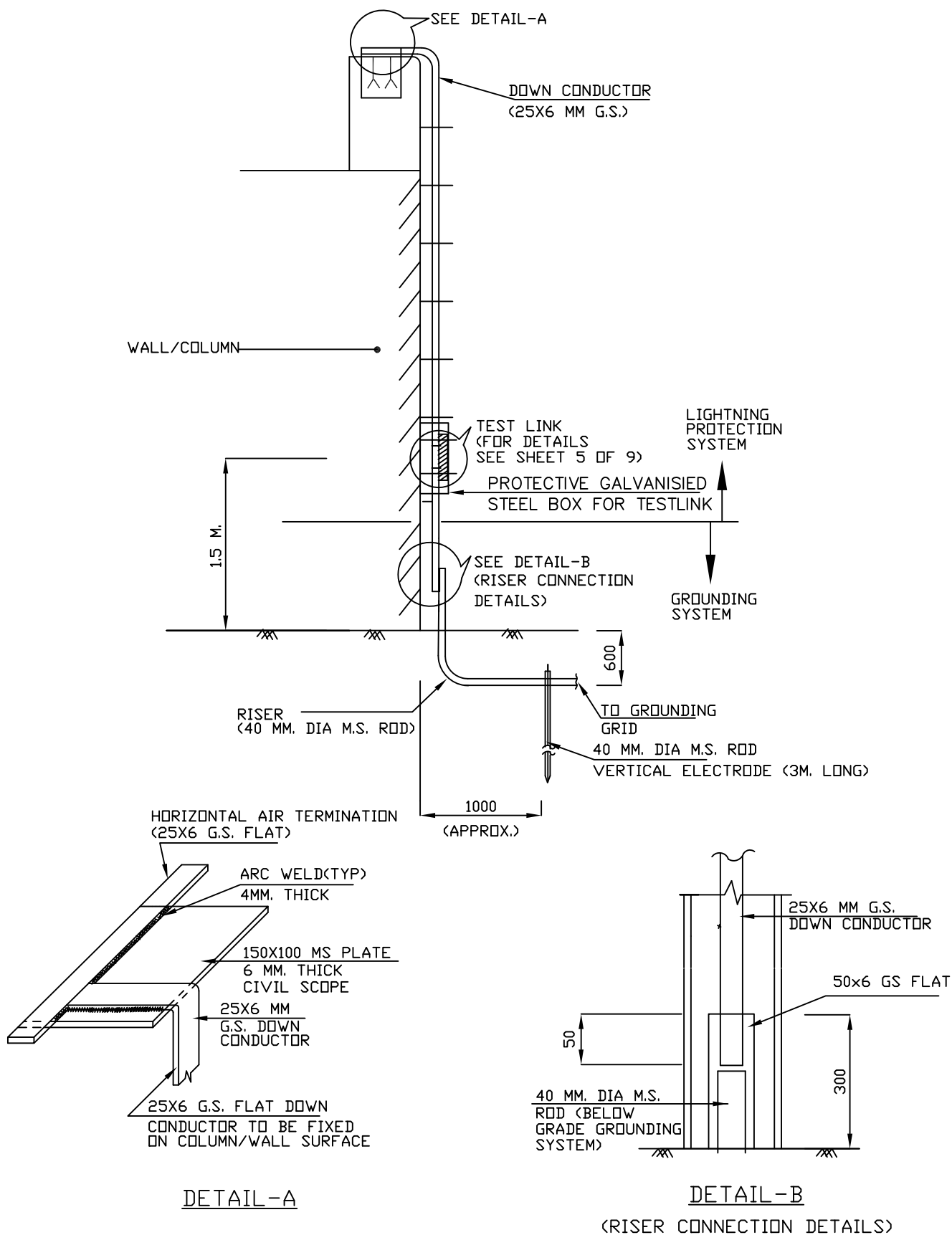
TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 5 OF 9



TYPICAL DETAILS OF CONNECTION AMONG
HORIZONTAL AIR TERMINAL, DOWN CONDUCTOR AND RISER

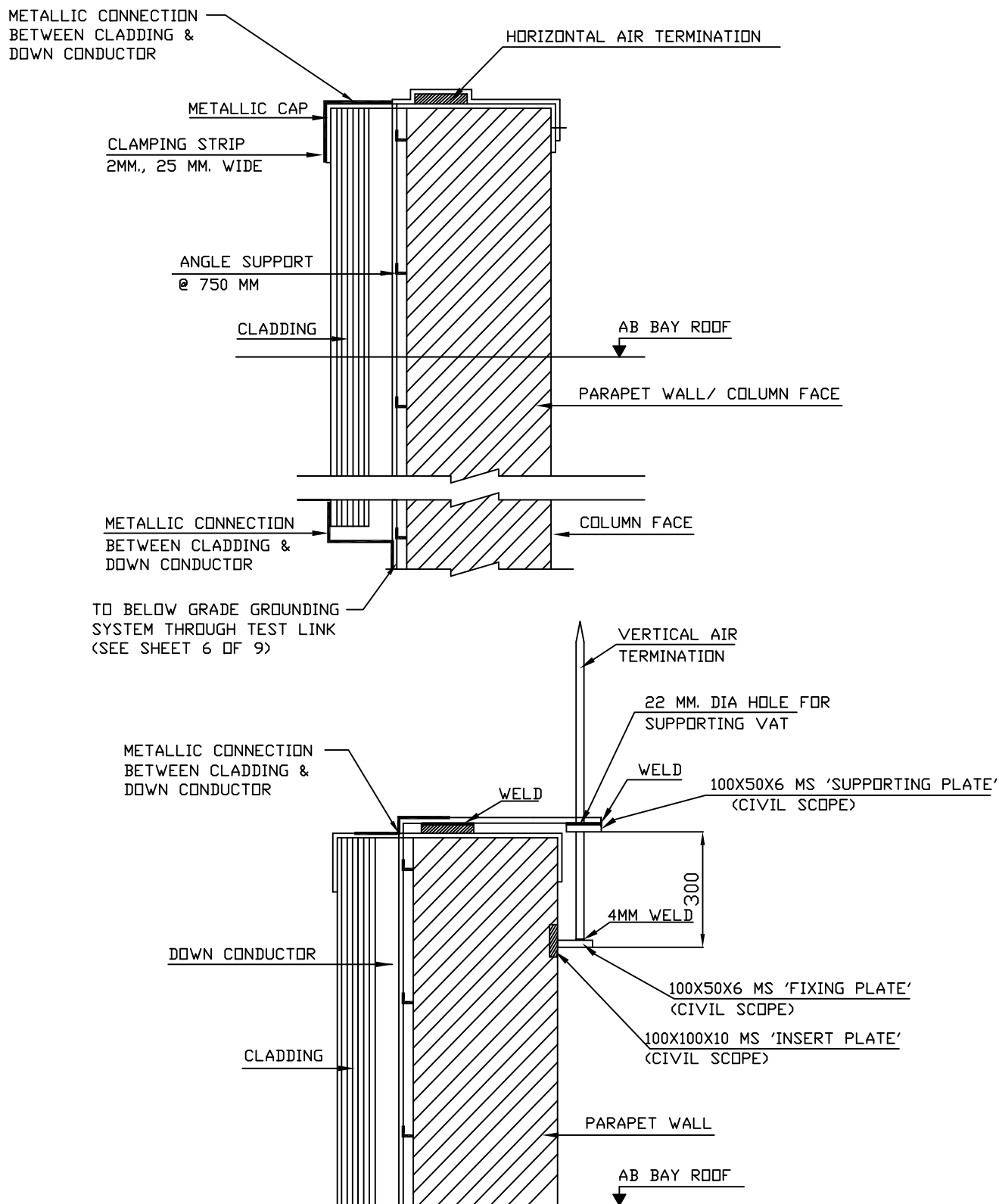
TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 6 OF 9



TYPICAL DETAILS OF CONNECTION AMONG
HORIZONTAL AIR TERMINAL, DOWN CONDUCTOR FOR 'A' ROW CLADDING

TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 7 OF 9

NOTES:—

1.0 AIR TERMINATIONS

- 1.1 HORIZONTAL/ VERTICAL AIR TERMINATION NETWORK WILL BE INSTALLED ON THE TOP OF ALL STRUCTURE/ BUILDINGS TO BE PROTECTED FROM LIGHTNING STROKES. THE INSTALLATION WORK SHALL BE DULY COORDINATED BY SITE WITH THE OTHER ACTIVITIES SUCH AS WEATHER PROOFING APPLICATION ON ROOF, ETC.
- 1.2 HORIZONTAL AIR TERMINATIONS SHALL BE OF 25MM x 6MM GALVANISED STEEL FLATS CLAMPED TO THE SURFACE AT EVERY 1000 MM. VERTICAL AIR TERMINATION'S SHALL BE 20 MM DIA GALVANISED MILD STEEL ROD 1000 MM LONG.
- 1.3 HORIZONTAL AIR TERMINATIONS NETWORK SHALL BE LAID AS PER IEC : 62305
- 1.4 THE VERTICAL AIR TERMINATION ROD WILL BE PROPERLY FIXED AS PER DETAILS GIVEN IN THE DRAWING ON THE TOP OF THE BUILDING/ STRUCTURE TO WITHSTAND VERY HIGH WIND PRESSURE. THE HORIZONTAL & VERTICAL AIR TERMINATIONS SHALL BE PROPERLY FIXED ON THE TOP OF ROOF OF THE BUILDINGS SUCH AS NOT TO MAKE THE PENETRATION IN THE WATER PROOFING LAYER

2.0 DOWN CONDUCTORS

- 2.1 THE DOWN CONDUCTORS SHALL BE 25MM X 6MM GALVANISED STEEL FLATS. ONE END OF DOWN CONDUCTORS SHALL BE CONNECTED TO THE VERTICAL/HORIZONTAL AIR TERMINATION NETWORK ON THE TOP OF ROOF/STRUCTURE AND THE OTHER END TO THE NEAREST EARTH TERMINAL. DOWN CONDUCTORS SHALL BE AS PER IEC : 62305
- 2.2 EACH DOWN CONDUCTOR WILL HAVE AN INDEPENDENT GROUND TERMINATION. IN NO CASE CONDUCTORS OF THE LIGHTNING PROTECTION SYSTEM WILL BE CONNECTED WITH THE CONDUCTORS OF THE GROUNDING SYSTEM ABOVE GROUND LEVEL. THE INDEPENDENT GROUND TERMINATION WILL COMPRISE OF A RISER CONNECTION FROM A 3000 MM LONG GROUND ELECTRODE (IN BHEL'S SCOPE) , WHICH IN TURN WILL BE CONNECTED TO THE BELOW GRADE GROUNDING SYSTEM. DETAILS OF THE ELECTRODE CONNECTION WITH EARTH MAT SHALL BE AS PER DRG No. PE-DG-435-509-E005 (TYPICAL BELOW GROUND EARTHING DETAILS).
- 2.3 THE CONNECTION BETWEEN EACH DOWN CONDUCTOR AND EARTH TERMINAL WILL BE MADE VIA A TEST LINK LOCATED AT APPROXIMATELY 1500MM ABOVE GROUND LEVEL.
- 2.4 THE DOWN CONDUCTORS WILL BE LAID STRAIGHT AND SHARP BENDS WILL BE AVOIDED AS FAR AS PRACTICABLE. THESE WILL BE FIXED ON THE OUTSIDE OF THE BUILDING WALL AND OR COLUMNS/STRUCTURES AT INTERVALS OF ABOUT 750 MM, AS INDICATED IN DRAWING.

TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 8 OF 9

- 2.5 ALL EXPOSED METALLIC PARTS OF A BUILDING WILL BE BONDED TO THE DOWN CONDUCTORS. SUCH PARTS WILL INCLUDE LADDERS, BALCONIES, CONDUITS, METALLIC SHEET CLADDING, ETC.
- 2.6 NO NATURAL DOWN CONDUCTOR SHALL BE CONSIDERED, DEDICATED DOWN CONDUCTORS SHALL BE CONSIDERED FOR LIGHTNING PROTECTION ARRANGEMENT.

3.0 JOINTING

- 3.1 MINIMUM NUMBER OF JOINTS IN THE LIGHTNING CONDUCTORS WILL BE PROVIDED.
- 3.2 ALL THE JOINTS WILL BE DONE BY ARC WELDING PROCESS. OVERLAPPING OF CONDUCTORS AT STRAIGHT JOINTS WILL NOT BE LESS THAN 150MM. THE CONTACT SURFACES WILL BE PROPERLY CLEANED BEFORE JOINTING.
- 3.3 THOSE PORTIONS OF GALVANISED STEEL FLATS, WHICH HAVE BEEN WELDED AT SITE, SHALL BE COATED WITH TWO (2) COATS OF RED OXIDE PAINT FOLLOWED BY TWO COATS OF ZINC PAINT.
- 3.4 THE VERTICAL AIR WILL BE COATED WITH WEATHER RESISTANT ANTI-CORROSIVE PAINT. (ZINC CHROMATE FOLLOWED BY TWO COATS OF ALUMINIUM PAINT)

4.0 LIGHTNING PROTECTION SYSTEM INSTALLATION SHALL CONFORM TO IEC : 62305 (INTERNATIONAL STANDARD FOR PROTECTION AGAINST LIGHTNING)

5.0 AS PER IEEE : 142, STEEL TANKS (CONTAINING FLAMMABLE LIQUIDS OR GASES) WITH STEEL ROOFS OR FLOATING METAL ROOF HAVING STEEL THICKNESS OF 4.76 MM OR MORE ARE TO BE CONSIDERED SELF-PROTECTING TYPE AGAINST LIGHTNING, & SHALL BE PROVIDED WITH MINIMUM TWO EQUALLY SPACED CONNECTIONS TO THE NEAREST BELOW GRADE GROUNDING SYSTEM.

6.0 CONDUCTORS OF THE LIGHTNING PROTECTION SYSTEM SHALL NOT BE CONNECTED WITH CONDUCTORS OF SAFETY EARTHING OF ABOVE GROUND LEVEL.

7.0 REFERENCE DRAWINGS:

- 6.1 TYPICAL ABOVE GRADE GROUNDING DETAILS, PE-DG-435-509-E004
- 6.2 TYPICAL BELOW GROUND EARTHING DETAILS, PE-DG-435-509-E005
- 6.3 DESIGN MEMORANDUM FOR LIGHTNING PROTECTION SYSTEM, PE-DC-435-509-E003

TITLE

TYPICAL LIGHTNING PROTECTION DETAILS

BHEL DOCUMENT No.
PE-DG-435-509-E006

REV. No. 00

SHEET 9 OF 9



SECTION-3.23: ILLUMINATION SYSTEM

1.0.0 INTENT OF SPECIFICATION

This specification covers requirements of Illumination system.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following for all plant buildings, non plant buildings, watch towers, boundary wall, roads, parking areas, outdoor areas, etc.

- a) Light pipe solar lighting system (100 nos.)
- b) Lighting fixtures
- c) Aviation obstruction lights for chimney & cooling tower
- d) Lighting distribution boards
- e) Lighting panels
- f) Receptacle panels
- g) Receptacles
- h) Minimum 25 nos. Lighting mast (Winch operated)
- i) Lighting poles
- j) Switchboxes
- k) Junction boxes
- l) Hand lamp units
- m) Conduits
- n) 100 nos. wall mounted fans
- o) Ceiling fans
- p) 25 nos. pedestal fans
- q) Wires
- r) Commissioning spares and consumables
- s) Mandatory spares
- t) Tools & tackles
- u) Any other equipment required for the system

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant Indian Standards, IEC publications and other standards as listed, except where modified and / or supplemented by this specification. The design and testing shall follow the following standards.

- a) IS: 1777 Industrial luminaire with metal reflectors.
- b) IS: 1913 General and safety requirements for Luminaires.
- c) IS: 10322-5-5 Luminaires- Flood lights
- d) IS/IEC 60079 -1 Equipment Protection by Flameproof Enclosures "d"
- e) IS: 2149 Luminaires for street lighting.
- f) IS: 2206 Flame proof electric lighting fittings
- g) IS: 4013 Dust-light electric lighting fittings.
- h) IS: 8224 Electric Lighting fittings for Div. 2 areas.
- i) IS: 9583 Emergency lighting units.
- j) IS: 9974 High Pressure sodium vapour lamps.



k) IS: 10322	Specification for Luminaires
l) IS: 732	Electrical wiring installation (system voltage not exceeding 650 V).
m) IS:5216	Guide for safety procedures and practices in electrical works.
n) IS: 12640	Residual Circuit operated Circuit breakers.
o) IS/IEC: 60947-1	low-voltage switchgear and control gear.
p) IS/IEC:60898-1	Miniature circuit breakers
q) IS/IEC 60715	Dimensions of low-voltage switchgear and control gear.
r) IEC: 60309-1	Plugs, socket-outlets and couplers for industrial purposes
s) IS/IEC 60529	Degrees of protection provided by enclosures (IP code)
t) IS: 694	PVC insulated cables for working voltages up to and including 1.1 kV.
u) IS: 9537	Conduits for electrical installation.
v) IS: 3480	Flexible steel conduits for electrical wiring.
w) IS: 1239	Mild steel tubes, tubular and other wrought steel fittings. (for size above 63 mm dia of rigid conduits)
x) IS: 14768	Fittings for rigid steel conduits for electrical wiring.
y) IS: 3837	Accessories for rigid steel conduits for electrical wiring.
z) IS: 14772	Boxes for enclosures of electrical accessories.
aa) CIE-173	Tubular day light guidance system

4.0.0 LIGHTING DESIGN

4.1.0 The plant lighting system shall comprise following categories :

- Tubular day light guidance system
- Normal 230 V AC Lighting System
- Normal-cum-Emergency 230 V AC Lighting System
- Emergency DC Lighting System

4.1.1 Tubular daylight guidance systems are linear devices that channel daylight into the core of a building. They consist of a light transport section with, at the outer end, some device for collecting natural light and, at the inner end, a means of distribution of light within the interior. Collectors may be either mechanical devices that actively focus and direct daylight (usually sunlight), or be passive devices that accept sunlight and skylight from part or whole sky hemisphere. The transport element is usually a tube lined with highly reflective or prismatic material or may contain lenses or other devices to redirect the light. Light is distributed in an interior by output components, commonly diffusers made of opal or prismatic material.

4.1.2 Normal AC lighting shall be provided by lighting distribution boards and lighting panel distributed throughout the plant. Supply to these lights shall be ON as long as the station AC supply is available. AC lighting fixtures shall be fed from respective area lighting panels. If fault level at lighting panel is more than 10 kA, lighting distribution boards shall be fed through 415/433 V ratio lighting transformers.

4.1.3 Emergency AC lighting shall be provided by DG set through unit emergency switchgear and lighting distribution boards. In main plant area, about 20% lighting shall be fed from AC emergency source.

4.1.4 In main plant area and other auxiliary plants, emergency DC lighting shall be provided in control rooms, in critical operating area, and for safe exit in case of black out. These lights shall be fed from DC distribution board backed by DC batteries. These lights shall be of LED type. DC lights shall remain continuously ON along with AC lighting system.

4.1.5 For Off-site buildings, where DC supply is not available, Emergency lighting units with integral batteries shall be used. Offsite area building emergency DC lighting shall be provided by self-contained emergency lighting fixtures. Each emergency fixture shall provide emergency light for



3-4 hours when the normal power source is lost. Each emergency light fixture shall be provided with Ni-cd gel battery, battery charger and two CFL lamps.

4.2.0 Tubular day light guidance system

- 4.2.1 The sunlight is captured from a transparent dome on the rooftop of a building and then the light travels through a daylight pipe (by way of multiple reflections from the daylight pipe's specular inside surface) to inside the building where sunlight is delivered to the indoor spaces through diffusers.
- 4.2.2 The transparent dome collects sunlight from above the roof level and then the daylight pipe guides the same to the interior spaces of a building. So, at the interface with open sky, the light pipe is provided with a transparent dome having the following attributes: adequate impact strength, sufficient daylight capture surface, high transmittance for the visible spectrum i.e. 400–750 nm, surface designed to scatter light uniformly; fire resistance, U-V stabilized, U-V blocking (up to 380 nm) and capable of preventing the ingress of moisture, dust, anti-bird measures, etc.
- 4.2.3 The light pipe system should have the following features: high impact strength; high transmittance for visible portion of sunlight spectrum i.e. 400–750 nm; purest color rendition (no color shift); U-V stabilized; U-V blocking (up to 380 nm); fire resistance; low attenuation of solar radiation while traversing the length of light pipe and any bends therein; minimal transmission of heat along with daylight; (preferably) low aspect ratio (length : diameter); and arrangement for control of available sunlight. For negotiating non-straight paths, light pipe bends should also be available. The daylight pipe and associated items are required to be maintenance free.
- 4.2.4 The diffuser should be designed so as to achieve the following goals: transmittance of required amount of daylight and to spread it efficiently throughout the space to be illuminated; there should be no glare; visual comfort; 99% U-V blocking (up to 380 nm); resistance to impact; fire resistance; prevent ingress of moisture and dust; U-V stabilized; control of light output, including switching off the light during daytime.
- 4.2.5 While installing the daylight pipe, correct type of roof flashing should be used so that no ingress of water, dust, etc. takes place at the junction between masonry work and daylight pipe. The dome, light pipe and diffuser should be electrostatically neutral during installation.

4.3.0 Lighting shall be provided in all the areas of power plant. Lux level proposed are given below:

S. No.	Area	Lux level
1.	Turbine Hall (operating floor)	200
2.	Turbine Hall other floors	100
3.	Boiler Platforms & ESP platforms	100
4.	Switch gear /MCC rooms, Battery room, DG Room, Elevator machine room	200
5.	Transformer yard	50
6.	Gas insulated switchgear building	200
7.	Control room	400/500
8.	Control equipment room	300
9.	Office area	300
10.	Air compressor house	150



S. No.	Area	Lux level
11.	Crusher house, Transfer tower and other indoor areas of coal handling plant	150
12.	Pump houses, WTP area, Chlorination building, AHU room	150
13.	Sea water intake pump house	150
14.	Main Road	20
15.	Secondary Roads	10
16.	Cable galleries	100
17.	Stair cases, Passages, Toilets	100
18.	Stockyard	30
19.	Conveyors	50
20.	Tank area and outdoor equipment location	20
21.	Chimney platforms	100

4.4.0 For indoor Areas, average lumen method shall be adopted to calculate luminance. Lighting level design shall include a Maintenance factor as follows to account for lamp lumen depreciation, luminaries' surface dirt and room surface dirt, etc.

- Air-conditioned clean interiors such as office rooms, Control and Electrical room : 0.8
- Clean interiors such as office rooms, laboratories : 0.75
- Industrial areas with normal interiors such as workshops. : 0.7
- Industrial areas with dusty interiors : 0.6
- Industrial areas with very dusty interiors : 0.5

4.5.0 Lighting level design shall also include the coefficient of utilization factor as calculated from table of reflectance provided by manufacturer for respective type of fixture.

4.6.0 For Outdoor flood lighting design, 'point by Point' method shall be adopted based on computer aided design package of the Contractor software. Uniformity in horizontal illuminance E_{min}/E_{avg} should be greater than 0.25.

4.7.0 Lighting for chimney

4.7.1 Chimney shall be provided with aviation obstruction lights. Aviation obstruction lights shall meet the requirements of Annexure-14 of 'International Civil Aviation Organization' (ICAO). Lights shall be of high intensity type or combination of medium intensity and low intensity. In case of later option, day time marking shall be provided on chimney as per the requirements of ICAO.

4.7.2 Number of levels of installation for obstruction lights shall be provided as per ICAO. Four lights shall be spaced at quarter points around the chimney at each elevation level. Photoelectric lighting controls shall adjust the lighting to one of three illumination levels depending on ambient light conditions (daylight, twilight, or night). All obstruction lighting fixtures shall be suitable for lamp replacement from internal platforms. Necessary swing door arrangement shall be provided for aviation obstruction lights.

4.7.3 Temporary aviation lights shall be installed above the top most point of the obstruction as construction progresses. This arrangement shall continue to exist till permanent arrangement to provide such lights are completed.



- 4.7.4 Aviation obstruction lighting shall be powered from AC emergency power supply.
- 4.7.5 Lighting shall be provided for various platforms and ground floor. Lighting fixture with LED lamps shall be provided to have maintenance free installation.

4.8.0 Aviation obstruction lights for natural draught cooling tower (NDCT)

- 4.8.1 NDCT shall be provided with aviation obstruction lights. Aviation obstruction lights shall meet the requirements of Annexure-14 of 'International Civil Aviation Organization' (ICAO). Lights shall be of medium intensity type.
- 4.8.2 Number of lights at each level shall be provided as per ICAO. Photoelectric lighting controls shall adjust the lighting to one of three illumination levels depending on ambient light conditions (daylight, twilight, or night).
- 4.8.3 Temporary aviation lights shall be installed above the top most point of the obstruction as construction progresses. This arrangement shall continue to exist till permanent arrangement to provide such lights are completed.
- 4.8.4 Aviation obstruction lighting shall be powered from AC emergency power supply.

4.9.0 LIGHTING CONTROL

- 4.9.1 Switch control shall be provided for controlling lighting fixtures located indoor.
- 4.9.2 Electric power to light fixtures located outdoors shall be switched with photoelectric controllers and timers. Provision shall be made to bypass the photoelectric controller and timer. For Road lighting, alternative lighting fixtures shall be fed from different phases.
- 4.9.3 Load on each lighting circuit and single phase receptacle circuit shall be limited to about 1500 W and the number of luminaries connected to lighting circuit shall be limited to about fifteen (15).
- 4.9.4 Electronic ballasts shall be provided for fluorescent fittings. For main plant control room, low loss copper ballast shall be provided. All the fixtures shall be provided with rapid start lamps and long life ballasts.
- 4.9.5 At least one 6/16 ampere, 230 volt AC universal socket outlet with switch shall be provided in offices, cabins, etc. In service building, atleast 4 nos. 5 Amp plug points shall be provided in each cubicle. Receptacles with decorative cover plates shall be used in office / Control rooms.
- 4.9.6 20 Amp, 230 V, Single phase convenience receptacle with switch shall be provided in plant area. The convenience outlets shall be spaced to provide access to any point in the interior industrial areas with a 25 meter extension cord.
- 4.9.7 63 Amp, 415 V, 3 phase welding receptacle with switch shall be provided in plant area. The receptacles shall be provided in all the floors of power house building at 50 m interval along A-row and B-row. Further in Boiler at alternate floors, welding receptacles shall be provided. In ESP top platform welding receptacle at 100 m interval shall be provided. In chimney at alternate floors, welding receptacles shall be provided. In outdoor locations, in the vicinity of major equipment, welding receptacles shall be provided. In pump houses, water treatment plant, compressor house, coal crushers, mill bay, coal transfer towers, ash handling plant, fuel oil pump house, H2 plant, GIS building, Switchyard, etc., minimum one welding receptacle shall be provided at each elevation at each enclosed area. In Transformer yard, 4 nos. 63 Amp welding receptacle and 4 nos. 250 Amp receptacle with MCCB unit shall be provided to extend power for oil filtration units during maintenance.



- 4.9.8 Each receptacle panel shall be provided with one earth leakage circuit breaker rated 30 mA in outgoing circuits.
- 4.9.9 In areas with hazardous atmospheres such as Hydrogen generation plant, fuel oil pump house, oil decanting pump house, lighting and convenience outlets shall be flame proof type. Receptacles located in Conveyor galleries shall be flame proof type.
- 4.9.10 Wall mounted fans shall be provided for all cubicles of admin building, service building, laboratories and other non-plant buildings.
- 4.9.11 Search lights of halogen lamps having adequate coverage shall be provided in watch towers.

5.0.0 EQUIPMENT DESCRIPTION

5.1.0 LIGHTING FIXTURES

- 5.1.1 For all service building, admin building, laboratory, conference rooms, SWAS room etc., LED lamp light fittings shall be used.
- 5.1.2 For other buildings/installations having room height of up to 5 metre, Fluorescent light fittings of following types shall be used:
- Industrial trough type/Industrial General purpose Rail type for all industrial areas
 - Corrosion proof type for battery room and chemical areas, etc.,
 - Anti-glare mirror optic type for Control rooms housing VDUs.
 - Mirror optic type for other Control rooms.
- 5.1.3 In false ceiling areas, type of light fixtures shall suit the type of false ceiling provided.
- 5.1.4 For low bay and medium bay areas, LED light fittings of well glass / medium bay type shall be used for the installations having room height of above 5 metre.
- 5.1.5 For high bay areas, light emitting plasma (LEP) light fittings shall be provided.
- 5.1.6 For outdoor areas involving road lighting and flood lighting, light emitting plasma (LEP) light fittings shall be provided.
- 5.1.7 Road lighting / Flood lighting poles shall be of galvanised steel pole. Each Street lighting pole/Flood lighting pole shall be provided with MCB protection.
- 5.1.8 Winch operated high mast lighting shall be provided in select outdoor areas such as transformer yard, switchyard, coal yard, stock yard, fuel tank farm etc.
- 5.1.9 For DC lighting LED lights shall be used.
- 5.1.10 Flame proof equipment shall be provided in H2 plant, coal tunnels, underground conveyor gallery, and Fuel Oil unloading & forwarding areas.
- 5.1.11 AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of $\pm 10\%$, frequency variation of $\pm 5\%$ and combined voltage and frequency variation of absolute sum of 10%. DC lighting fixtures and accessories shall be suitable for operation on 220 V, DC with variation between 190 V & 240 V.
- 5.1.12 Power factor of fluorescent lamp fixtures shall be not less than 0.90. Suitable power factor improving capacitors shall be provided for this purpose. Capacitors shall be hermetically sealed in aluminium enclosures to prevent seepage of impregnate & ingress of moisture.



- 5.1.13 Luminaires shall meet atleast Electrical safety class-I as per relevant IEC.
- 5.1.14 The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.
- 5.1.15 Twin fluorescent lamp fixtures shall be wired in lead lag circuit to minimise stroboscopic effect.
- 5.1.16 High bay fixtures shall be suitable for pendant mounting and provided with safety chains.
- 5.1.17 Fluorescent Tubular Lamp shall be 36 Watt rated, cool day light type with Triband Phosphor having lumen output of 3250 lumens.
- 5.1.18 High Frequency Electronic ballast shall be suitable for 1X36 Watt FTL / 2X36 Watt FTL. Operation at high frequency shall increase lumen output. It shall conform to IS 13021 (Part I). It shall have following features:
- System loss less than 4 Watt.
 - Circuit power factor 0.95 or better
 - No humming noise.
 - Protected against mains disturbances.
 - Automatic cut off protection for a de-activated tube.
- 5.1.19 Copper Ballast shall be low loss design, copper wound, silicon lamination, manufactured using Vacuum pressure impregnation technology. Winding temperature shall not exceed 70 degC over an ambient of 50 deg C.
- 5.1.20 Recommended luminaries at various places are listed below :

Sl. No.	Area	Type of Luminaries
1	Turbine Hall operating floor	LED high bay
2	Turbine building other floors	LED Medium bay/ well glass
3	Switch gear /MCC rooms	Fluorescent industrial fixture
4	UPS, Battery charger room,	Fluorescent industrial fixture
5	Lead acid battery Room	Corrosion proof fluorescent fixture
6	Boiler area/ESP area	LED well glass
7	Cable galleries	LED well glass fixture
8	Stair cases, Passages, Toilets	Fluorescent rail type fixture/Mini lights
9	Office	Mirror optics, decorative Fluorescent fixture
10	Chemical house/ Chlorination plant	Fluorescent Corrosion proof surface-bracketed mounted
11	Control rooms with PCs/VDUs	Mirror optics non-glare type Fluorescent fixture
12	Air compressor house	LED Medium bay
13	GIS building	LED Medium bay
14	Water treatment plant/ DM plant	Fluorescent industrial fixture / LED / well glass
15	Fuel oil Pump House	Flameproof luminaries
16	DG Room	LED well glass fixture



Sl. No.	Area	Type of Luminaries
17	Emergency 220 V DC Lighting	DC LED Lamps
18	Transformer yard / Outdoor Area	LEP plasma type flood lighting fixtures on steel poles / Masts
19	Pump houses	LED Medium/LEP plasma High bay
20	Roads	LEP plasma type street light fixtures on galvanized Steel poles

5.2.0 Lighting distribution board

Lighting distribution board shall comprise, TPN MCCB as incomer and required no.of TPN MCCB feeders as outgoing feeders to feed lighting panels and receptacle panels. Construction of lighting DB shall be similar to ACDB and is detailed in LV switchgear section.

5.3.0 Lighting Panels & Receptacle Panel

- 5.3.1 The panels shall be rated for 415 V, 3 phase, 4 wire, AC with neutral bus and suitable for either wall/column mounting. Indoor panels shall have degree of protection of IP 54 and outdoor type shall have degree of protection of IP 55 and shall have a sloping canopy. Panels shall be constructed from CRCA sheet. Sheet thickness shall be 2.0 mm.
- 5.3.2 Miniature circuit breakers (MCB) shall have thermal elements for overload protection and an instantaneous magnetic trip to protect against severe faults. All MCBs provided shall be suitable for breaking capacity of 10 kA (minimum) at 240 V AC.
- 5.3.3 Contactors shall be of the air break type fitted with arc shields. Time switch shall be suitable for automatic switching ON and OFF of street lighting / flood lighting circuits. Time switch has 00 - 24 hours clock base. Time switch shall indicate actual time and shall permit accurate time setting. Time switch shall be provided with Ni-Cd gel battery.
- 5.3.4 Lighting panel shall be provided with 415 V AC, 63 Amp, TPN MCB with ELCB as incomer, required nos. of 20 A, 240 V AC, single pole MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit.
- 5.3.5 DC lighting panel shall be provided with 220 V DC , 63 Amp, DP MCB isolator as incomer, required nos.of 20 A, 220 V DC, double pole MCBs for outgoing circuits.
- 5.3.6 Street lighting panel shall be provided with 415 V AC, 63 Amp, TPN MCB isolator as incomer, 63 Amp Three pole AC Contactor, 00 - 24 hours timer and a photo-electric switch for automatic switching of contactor, a by-pass switch for timer/photo switch, 6 Nos. 20 A, 415 V AC, TPN MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit. One number light sensor in weather proof enclosure having IP: 55 degree of protection shall be installed separately with necessary interconnecting cable for each street lighting panel. Additionally 100% sensors shall be supplied for future use
- 5.3.7 Receptacle panel shall be provided with 415 V AC, 63 Amp, TPN MCB with ELCB as incomer, 6 Nos. 20 Amp, 240 V AC, single pole MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit.

5.4.0 Three Phase Industrial Receptacles

The receptacle shall be of 63 A, industrial heavy duty insulated type with 5 pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic enclosure of IP-55 protection



class. Socket shall be provided with safety cover. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

5.5.0 Three Phase Flame proof Industrial Receptacles

The receptacle shall be of 63 A, industrial heavy duty insulated type with 5 pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic flame proof enclosure of IP-65 protection class. Socket shall be provided with safety cover.

5.6.0 Single Phase Industrial Receptacles

The receptacles shall be heavy duty type rated for 20 A, 240 V AC supply the receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic enclosure of IP-55 protection class. Socket shall be provided with safety cover. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

5.7.0 Single Phase Flame proof Industrial Receptacles

The receptacles shall be heavy duty type rated for 20 A, 240 V AC supply. The receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic flame proof enclosure of IP-65 protection class. Socket shall be provided with safety cover.

5.8.0 Flush type indoor receptacles

Flush type 3 pin, 6/16 A, 240 V AC sockets shall be provided for office rooms and control rooms. The receptacle shall be complete with 16 A modular type switch & safety shutter. It shall be housed in suitable thermoplastic enclosure.

5.9.0 Lighting mast

5.9.1 Each Lighting Mast shall be 20 to 30 M high, complete with the following accessories.

- High mast shaft in two/three section, hot dip galvanised
- Head frame, steel wire rope & double drum winch.
- Galvanised Lantern carriage arrangement
- Integral power tool installed inside base compartment for its operation.
- Foundation bolts
- Luminaires
- Aviation obstruction light with 2 nos. LED lamps.
- Control panel
- Power & control cables and cabling accessories required for the installation.
- Special tools & tackles

5.9.2 The High mast shall be of continuously tapered, polygonal cross section, at least 20 sided, presenting a good and pleasing appearance and shall be based on proven design to give an assured performance, and reliable service. The entire fabricated mast shall be hot dip galvanized, internally and externally, having a uniform average thickness of atleast 85 microns.

5.9.3 An adequate door opening shall be provided at the base of the mast and the opening shall permit clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch.

5.9.4 A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fittings and control gearboxes. The lantern carriage shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets.



- 5.9.5 The winch shall be completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when not in use, gravity activated PAWLS. Individual drum also shall be operated for fine adjustment of lantern carriage. The minimum-working load shall be not less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers.
- 5.9.6 The suspension system shall essentially be without any intermediate joint and to consist of only non-corrodible stainless steel of AISI 316 grade. The breaking load of each rope shall not be less than 2350 kg, giving a factor of safety of over 5 for the system at full load. The thimbles shall be secured on ropes by compression splices.
- 5.9.7 A suitable, high-powered, electrically driven, internally mounted power tool with motor, with manual over ride shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The power tool shall be of single speed, provided with a motor of the required rating. The power tool shall be supplied complete with suitable control.

5.10.0 Lighting poles

Lighting pole shall be octagonal type, galvanized steel, supplied with base plate, foundation bolts, and necessary fixing-bracket for fixing the luminaire. Street lighting pole shall have integral junction box. All poles shall be provided with heavy square nuts on the anchor bolts under the pole base plate and hex nuts on the top. GI conduits shall be embedded in muff for incoming and outgoing cables. Height of poles shall be about 10 m. Junction box shall be integral to the pole, supplied along with MCB and neutral link.

5.11.0 Wires

XLPE/PVC insulated wires shall have multi stranded copper conductor. Wires shall be of 1.5 sq.mm/2.5 sq.mm/4 sq.mm sizes. The insulation material shall be resistant to flame, oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling. Wires shall have following colors.

- Red for R phase
- Yellow for Y phase
- Blue for B phase
- Black for Neutral
- Yellow-Green for Earth wire
- Grey & white for positive and negative connections respectively.

5.12.0 Rigid Conduits and Fittings

Rigid conduits shall conform to the requirements of IS: 9537 (Part I & Part II). However conduits above 63 mm diameter shall conform to the requirements of IS: 1239. All conduits and pipes shall be of medium duty. The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS: 4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS: 6005.

Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes. All fittings shall be screwed type and hot dip galvanized inside and outside.

In corrosive areas, epoxy coated conduits shall be provided.



5.13.0 Flexible Metallic Conduits and Fittings

Flexible metallic conduits shall conform to the requirements of IS: 3480. Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout. The strip shall be electro galvanized to a minimum thickness of 25 microns. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS: 6005. Flexible conduits shall be supplied with suitable end coupler nipple and check nut.

5.14.0 GI pipes shall be of medium duty as per IS: 1239

5.15.0 Hume pipes shall be of reinforced concrete conforming to class NP3 for road crossings as per IS: 458.

5.16.0 Switch Boxes

The switch boxes shall be of surface/flush mounting type with steel construction. Switch boxes shall have conduit knock out on the sides. The switches shall be of quick make and quick break type and shall be of modular type. Where required, 3 pin 240 V type receptacles shall be provided with safety shutter and modular switch in the switch box. The switch box shall be flush mounted in places such as control rooms and office rooms.

Switches furnished shall be 6 or 16 Amps, 240 Volt totally enclosed modular type with side connected screw type terminals, phenolic compound housing and operating levers, and single mounting yoke design.

Switches used for switching direct current shall be 10 amperes, 240 Volt T-rated AC/DC switches.

5.17.0 Lighting Junction Box

The junction boxes shall be of FRP weather proof type. 650 Volt grade multiday terminal blocks complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires in the junction boxes. The Junction box shall be suitable for mounting on wall/column/poles/masts.

5.18.0 Hand lamp units (24 V Supply Module)

Hand lamp unit shall comprise 240/24 V transformer with 3 pin 24 Volt hand lamp socket. Required MCB protection shall be provided at the incomer. The unit shall be enclosed in sheet steel enclosure. 24 V hand lamp with guard and flexible cord of at least 15 Metre length shall be supplied as specified. Module shall be portable box type suitable for providing local lighting requirements during maintenance and inspection.

5.19.0 Fans

Ceiling fans shall be of reputed make, BIS approved, 1200 mm sweep complete with copper wound, class E insulated motor, and three nos. balanced blades, suspension rod, canopy and other accessories conforming to applicable IS. Ceiling fans shall be supplied with a wall mounted controller to turn the fan on and off and to vary the fan speed from 0 to 100%. Controller shall be Electronic type free from humming noise.

Pedestal fans shall be of reputed make, BIS approved, 500 mm sweep, complete with aluminium blades, cast iron base, copper wound, class E insulated motor, support column, control switch and other accessories conforming to applicable IS.

**6.0.0 INSTALLATION**

6.1.0 The bottom of wiring devices shall be mounted the following distances above the finished floor.

Wiring Devices	Location	Distance above Floor (minimum)
Receptacles	Offices and finished areas	500 mm
Receptacles	All other locations	900 mm
Switches	All locations	1500 mm
Ceiling fan control	All locations	1500 mm
Ceiling fans	All locations	2500 to 3000 mm

6.2.0 The location of the light fittings, receptacles, switches, etc. shall be such as to avoid interference with piping / ventilation ducts / busduct or other equipment and to avoid objectionable shadows and glare.

6.3.0 In false ceiling areas the switchgear and the conduits shall be recess mounted.

6.4.0 In all Office rooms & Control rooms conduit shall be concealed type. In, admin building, canteen, dispensary, , concealed conduit wiring shall be adopted.

6.5.0 Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. Nylon rawl plug shall be offered.

6.6.0 In the rooms where false ceilings are provided, the lighting fixtures shall be supported separately by false ceiling grid over false ceiling if it is of steel structural or from ceiling or from cable trough / channel and not by the false ceiling board. The arrangement shall be to the approval of Owner.

6.7.0 A four (4) way terminal junction box shall be provided near each lighting fixture, for loop-in, loop-out and off connection of lighting wires or as required.

6.8.0 Conduit shall be routed at least 150 mm from the insulated surfaces of hot water, steam pipes and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cable shall be used.

6.9.0 Conduits supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm vertical runs.

6.10.0 Conduit shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs.

6.11.0 Wiring for indoor Lighting installation shall be carried with insulated wire following sizes laid in Galvanised steel conduit of

- Lighting Panel to lighting Fixtures : 2.5 sq.mm copper
- Lighting Panel to Switch box : 2.5 sq.mm copper
- Switch box to lighting Fixtures : 1.5 sq.mm copper
- Lighting Panel to Sockets : 4 sq.mm copper

6.12.0 Voltage drop in the cable shall be limited as follows,

- Lighting panel to lighting fixtures :3%
- Switchbox to lighting fixtures :1.5%



- Lighting panel to socket :3%
 - Lighting panel to switch box :1.5%
- 6.13.0 For outdoor lighting & road lighting, XLPE insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed cables shall be provided.
- 6.14.0 Wiring for lighting circuits of Normal AC system, Emergency AC System and DC system shall run in separate conduits.
- 6.15.0 Wiring for lighting fixtures and receptacle units shall be fed from different circuits and shall run in separate conduits.
- 6.16.0 Two different phase circuits shall not be laid in the same conduit.
- 6.17.0 Ceiling fans with variable speed electronic regulators shall be installed in the non-air-conditioned areas as specified.
- 6.18.0 Ceiling Fans & pedestal fans for of required size and quantity to be provided in individual rooms / areas like Workshop, Stores, Office building / areas, Service building, etc.
- 6.19.0 Receptacles and lighting circuits shall be fed from different circuits. The switch controlling these circuits shall be on the live side (phase wire) of the circuits.
- 6.20.0 Wiring shall be spliced only at junction boxes. Maximum two wires shall be connected at each terminal.
- 6.21.0 Lighting branch circuits, telephone circuits, and intercommunication circuits shall be routed in conduit. Lighting circuits shall be routed in electrical metallic tubing (EMT) for indoor areas, rigid conduit for hazardous and outdoor areas.
- 6.22.0 All conduit system shall be sized considering fill criteria specified in IS: 732.
- 6.23.0 Each lighting poles and lighting / lightning mast junction box shall be earthed by 25 x 3 mm GS flat bonded to one (1) 20 mm dia MS earth electrode of 3 meter length driven vertically in the ground.
- 6.24.0 The lights shall not be fixed at gantry. In buildings it shall be fixed with suitable fixtures and not directly on the walls.
- 6.25.0 One (1) no. of mini truck mounted with adjustable hydraulic lift for the maintenance of street lights.
- 6.26.0 For the maintenance of lighting fixtures within the high bay areas, four (4) nos. free standing adjustable aluminium ladder, adjustable from 5 m to 10 m shall be provided.
- 6.27.0 Three nos. Portable Aluminium Ladders of various sizes suitable for main control room, switchyard control room etc., shall be provided.

7.0.0 TESTS

Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. For the various bought out item test certificates from equipment Manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards.



8.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Design basis report
- Illumination design calculation
- Tubular day light guidance system
- GA drawing and single line diagram of lighting distribution board
- GA drawing and single line diagram of lighting panel & receptacle panels
- GA drawing of poles and masts
- GA drawing of receptacles
- General arrangement drawings of lighting fixtures
- Lighting design software
- Technical data sheet
- Test reports
- Catalogues
- Illumination layout for Transformer Yard
- Illumination layout for GIS building
- Illumination layout for switchyard control building
- Illumination layout for Switchyard
- Illumination layout for Power house building
- Illumination layout for Boiler and mill bay
- Illumination layout for ESP
- Illumination layout for plant roads
- Illumination layout for Main control building
- Illumination layout for Control room
- Illumination layout for outdoor yards
- Illumination layout for coal handling plant
- Illumination layout for Ash handling plant
- Illumination layout for Water treatment plant
- Illumination layout for Chimney
- Illumination layout for Cooling tower
- Illumination layout for Sea water intake system
- Illumination layout for Fuel handling system
- Illumination layout for CWPH
- Illumination layout for Electro chlorination plant
- Illumination layout for other auxiliary plant buildings
- Illumination layout for Admin building
- Illumination layout for Service building
- Illumination layout for Watch tower
- Illumination layout for Boundary wall
- Illumination layout for other non-plant buildings
- Illumination and Small power distribution arrangement
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 09.05.2018
		SHEET : 1 OF 1

Section-D

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101																														
		VOLUME NO. : II-B																														
		SECTION : D																														
		REV NO. : 00 DATE : 07.05.18																														
		SHEET : 1 OF 4																														
1.0	INTENT OF SPECIFIATION																															
	The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station. Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.																															
2.0	CODES AND STANDARDS																															
	Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards: <table><tr><td>IS:325</td><td>Three phase Induction motors</td></tr><tr><td>IS : 900</td><td>Code of practice for installation and maintenance of induction motors</td></tr><tr><td>IS: 996</td><td>Single phase small AC and universal motors</td></tr><tr><td>IS: 4722</td><td>Rotating Electrical machines</td></tr><tr><td>IS: 4691</td><td>Degree of Protection provided by enclosures for rotating electrical machines</td></tr><tr><td>IS: 4728</td><td>Terminal marking and direction of rotation rotating electrical machines</td></tr><tr><td>IS: 1231</td><td>Dimensions of three phase foot mounted induction motors</td></tr><tr><td>IS: 8789</td><td>Values of performance characteristics for three phase induction motors</td></tr><tr><td>IS: 13555</td><td>Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment</td></tr><tr><td>IS: 2148</td><td>Flame proof enclosures for electrical appliance</td></tr><tr><td>IS: 5571</td><td>Guide for selection of electrical equipment for hazardous areas</td></tr><tr><td>IS: 12824</td><td>Type of duty and classes of rating assigned</td></tr><tr><td>IS: 12802</td><td>Temperature rise measurement of rotating electrical machines</td></tr><tr><td>IS: 12065</td><td>Permissible limits of noise level for rotating electrical machines</td></tr><tr><td>IS: 12075</td><td>Mechanical vibration of rotating electrical machines</td></tr></table> In case of imported motors, motors as per IEC-34 shall also be acceptable.		IS:325	Three phase Induction motors	IS : 900	Code of practice for installation and maintenance of induction motors	IS: 996	Single phase small AC and universal motors	IS: 4722	Rotating Electrical machines	IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines	IS: 4728	Terminal marking and direction of rotation rotating electrical machines	IS: 1231	Dimensions of three phase foot mounted induction motors	IS: 8789	Values of performance characteristics for three phase induction motors	IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment	IS: 2148	Flame proof enclosures for electrical appliance	IS: 5571	Guide for selection of electrical equipment for hazardous areas	IS: 12824	Type of duty and classes of rating assigned	IS: 12802	Temperature rise measurement of rotating electrical machines	IS: 12065	Permissible limits of noise level for rotating electrical machines	IS: 12075	Mechanical vibration of rotating electrical machines
IS:325	Three phase Induction motors																															
IS : 900	Code of practice for installation and maintenance of induction motors																															
IS: 996	Single phase small AC and universal motors																															
IS: 4722	Rotating Electrical machines																															
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines																															
IS: 4728	Terminal marking and direction of rotation rotating electrical machines																															
IS: 1231	Dimensions of three phase foot mounted induction motors																															
IS: 8789	Values of performance characteristics for three phase induction motors																															
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment																															
IS: 2148	Flame proof enclosures for electrical appliance																															
IS: 5571	Guide for selection of electrical equipment for hazardous areas																															
IS: 12824	Type of duty and classes of rating assigned																															
IS: 12802	Temperature rise measurement of rotating electrical machines																															
IS: 12065	Permissible limits of noise level for rotating electrical machines																															
IS: 12075	Mechanical vibration of rotating electrical machines																															
3.0	DESIGN REQUIREMENTS																															
3.1	Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A																															
3.2	Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.																															
3.3	Starting Requirements																															
3.3.1	Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.																															
3.3.2	Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.																															

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 07.05.18
		SHEET : 2 OF 4
The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.		
3.3.3	The following frequency of starts shall apply i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature. ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour) iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable fro minimum 20,000 starts during the life time of the motor	
3.4	Running Requirements	
3.4.1	Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.	
3.4.2	Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.	
3.5	Stress During bus Transfer	
3.5.1	Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.	
3.5.2	Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.	
3.6	Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.	
3.7	The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.	
4.0	CONSTRUCTIONAL FEATURES	
4.1	Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy	
4.2	Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled	
4.3	Motors shall be designed with cooling fans suitable for both directions of rotation.	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 07.05.18
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".	
4.7.2	Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bare live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 07.05.18
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

	TITLE	LV MOTORS DATA SHEET-A	SPECIFICATION NO.	
			VOLUME	II B
			SECTION	D
			REV NO. 00	DATE 09.05.2018
			SHEET 1	OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	<200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree of Protection (Indoor/Outdoor)	:	IP55
5.0	Type of Cooling	:	TEFC/CACW
6.0	Details of supply system		
	a)	Rated voltage (with variation)	: 415V ± 10%
	b)	Rated frequency (with variation)	: 50 Hz (Variation: +3% TO –5%)
	c)	Combined voltage & freq. variation	: 10%
	d)	System fault level at rated voltage	: 50 kA for 1 sec
	e)	Short time rating for terminal boxes	
		o 90kW & Above	: 50 kA for 1 sec
		(Breaker controlled)	
		o Below 90kW (SFU/MCCB+:	50 kA for 0.20 sec.
		Contactors controlled)	
	f)	LV System grounding	: Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
11.0	Space heater supply	:	240 V, 1Φ, 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	Continuous duty LT motors up to 160 KW Output rating (At 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC: 60034-30.

For further detailing please refer specification

	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 09.05.2018
		SHEET 1 OF 2

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 09.05.2018
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN	CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ : VENDOR			TITLE QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			NUMBER :			
									SPECIFICATION TITLE			
SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR				BIDDER'S/VENDORS COMPANY SEAL			
			NAME									
			SIGNATURE									
			DATE									

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION :			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10		11	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 3 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION		
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 4 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III
									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT		SPECIFICATION :			
				BIDDER/ :			TITLE		NUMBER :			
				VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	FOR MV MOTOR
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

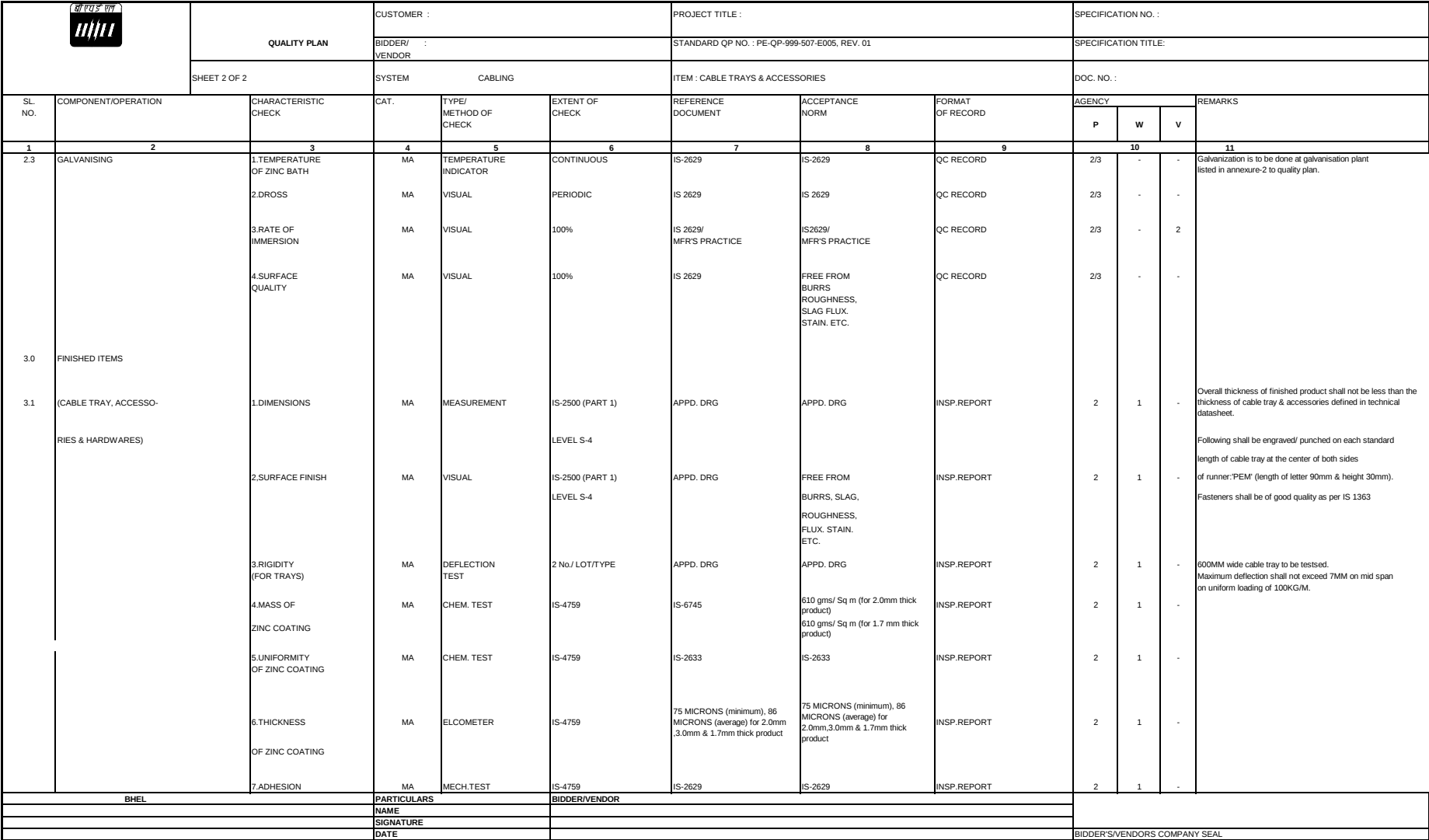
		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
				SHEET 7 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE					
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	1	^s NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1	^s NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	1	^s NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^s	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^s NOTE - 2
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE :			SPECIFICATION NO. :		
				BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-507-E005, REV. 01			SPECIFICATION TITLE:		
		SHEET 1 OF 2		SYSTEM CABLING			ITEM : CABLE TRAYS & ACCESSORIES			DOC. NO. :		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL											
1.1	ROLLED SHEET	1.CHEM.& PHY. PROPERTIES	MA	VERIFICATION OF TCS	100%	IS1079	IS1079	MILL TC	3/2	-	1/2	Steel shall be procured from SAIL/TISCO/RINL/BHUSAN/JINDAL STEEL/JINDAL ISPAT/ESSAR/ LOYD/ HISCO/ authorised SAIL Re Rollers.
		2.DIMENSIONS	MA	MEASUREMENT	100%	IS-1730/ APPD. DATA SHEET	IS-1730/ APPD. DATA SHEET	QC RECORD	3/2	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	IS-1079	IS-1079	QC RECORD	3/2	-	-	
1.2	ZINC	CHEM.COMP.	MA	CHEM TEST	EACH HEAT	IS-209	IS-209	TC	3/2	-	1/2	
2.0	IN-PROCESS											
2.1	FABRICATION	1.DIMENSIONS	MA	MEASUREMENT	100%	APPD.DRG.	APPD.DRG.	QC RECORD	2	-	1	Welding is to be done by qualified welders in accordance with ASME SEC. IX article III. WPS , PQR & WPQ to be reviewed during inspection.
		2.WELDING QUALITY	MA	VISUAL	100%	GOOD WELDING PRACTICE	FREE FROM DEFECTS & SLAG	QC RECORD	2	-	1	
		3.SURFACE FINISH	MA	VISUAL	100%	APPD.DRG.	APPD.DRG.	QC RECORD	2	-	1	
2.2	SURFACE PREPARATION	1.CLEANING PICKLING & RINSING & FLUXING	MA	VISUAL	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2	-	-	
		2. SURFACE QUALITY	MA	VISUAL	100%	IS:2629	IS:2629	QC RECORD	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION



1 - BHEL/ CUSTOMER

2 - VENDOR

3 - SUB- VENDOR

P - PERFORM

W - WITNESS

V - VERIFICATION

ANNEXURE-2 to Quality Plan

(LIST OF BHEL- PEM APPROVED GALVANIZERS)

SL. NO.	ITEM	VENDOR NAME	ADDRESS
1	Galvanising	Jenco Industrial Corporation	Chincholi Bunder Khkar Road Near Link Road Devruwadi Malad (W) Mumbai 400064
2	Galvanising	National Galvanizing Company	66, Barrackpore Kamarhatt Trunck Road Calcutta-700058
3	Galvanising	Sigma Galvanising Pvt. Ltd.	Plot No.C-169, TTC, MIDC Ind Area Navin Mumbai-400705
4	Galvanising	B.P. Projects PVT LTD	167A, Vivekananda Road Kolkata-700006
5	Galvanising	Standard Galvanisers	Makardah Road, Kabar Para, Bankra, Howarah -711403
6	Galvanising	Steel Products	National Highway No. 6, Chamrail, Kona, Howrah-711114
7	Galvanising	Unitech Fabricators & Engineers Pvt. Ltd.	Village- Ajab Nagar, P.O. -Molla Simlla, P.S. - Singur, Dist - Hoogly, Pin-712223
8	Galvanising	Shivam Engineers & Fabricators	A0-282-284, Industrial Area, South Side of G.T. Road, Ghaziabad, U.P.
9	Galvanising	B.G. Shirke Construction Technology Pvt. Ltd	72-76, Mundhawa, Pune - 401 036
10	Galvanising	Galbro Ispat Galvanizers Pvt. Ltd.	GUT 11 AND 12, OPP. Kudus Steel,Rolling Mill, Wada, Thane , Mumbai
11	Galvanising	Eros Metals	G-97, MIDC, Bhutibori , Nagpur
12	Galvanising	Industrial Perforation (India) Pvt. Ltd.	Ganganagr, Katakhal, Kolkata-700132
13	Galvanising	Indmark Formtech Pvt. Ltd.	Phase - 3, E - 11 / 1, M. I. D. C., Chakan, Pune - 410 501, Maharashtra, India.
14	Galvanising	Namdhari Industrial Traders Pvt. Ltd.	Village Latton Dana, Chandigarh Road, Ludhiana
15	Galvanising	Neha Galvaniser	Jalan Industrial Estate, Gate No-1, 1st Right Choise Lane, Near N.G-6, Jangalpur, PO Domjur Howrah - 700071, West Bengal, India
16	Galvanising	Patny Systems (P) Ltd.	Unit-IV, Sy No. -228/9, Plot No. 6, IP Kuchavaram, Toopran(M) Dist.- Medak, Telegana - 502336
17	Galvanising	Parmar Metal Company	Survey No.207,Veraval (Shapar) Dist. Rajkot, India.
18	Galvanising	Passive Infra Projects Pvt. Ltd	8th KM Stone, Sampla Kharkhoda Road, Hassangarh, Rohtak, Haryana
19	Galvanising	Rukmani Electrical & Fabricators Pvt, Ltd.	Urla Industrial Area, Urla Sarora Road, Raipur- 493 221 (Chhattisgarh) Shankharidaha Baniyarah, Jalan Industrial Complex, Gate no.3, Lane no. 4, Domjur, Howrah , W.B .- 71141
20	Galvanising	DMP Projects Pvt.Ltd.	Dulagarh Industrial Park , PS-Sankrail , Howrah -711302
21	Galvanising	Vinfab Engineers India Private Limited	Gut no. 224/1 &2 Bhiwandi Wada State Highway, Village khupri, Dist. Thane, Maharashtra -421303
22	Galvanising	Saral Projects & Processors	B-1, Industrial Area, Site-II, Amawan Road Rae Bareli
23	Galvanising	Jamna Metal Company	D - 1513, DSIDC, Narela Industrial Area Delhi - 110040, India
24	Galvanising	Brahampuri Steels Limited	172 (F) Industrial Area, Jhotwara, Jaipur-302013
25	Galvanising	Indiana Gratings PVT. LTD	F-5, MIDC Jejuri, Pune-412 303

NOTES:

1. ANY CHANGE IN THE ABOVE LIST SHALL BE INFORMED AT THE TIME OF SPECIFIC PROJECT REQUIREMENT AND NO COMMERCIAL IMPLICATION SHALL BE ALLOWED ON THIS ACCOUNT.
2. IT SHALL BE THE RESPONSIBILITY OF THE VENDOR TO GET THE MATERIAL GALVANIZED FROM THE ABOVE LIST WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL.

MANUFACTURING QUALITY PLAN							QAP DOC. NO.:							
SL NO		COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPT-ANCE NORMS	FORMAT OF RECORD	*D	AGENCY			REMARKS
											1	2	3	
CUSTOMER: _____ PRODUCT: FRP CABLE TRAYS & ACCS.							INSPECTION CATEGORY : BULK ITEMS							
							PAGE 1 OF 2							

1.0	RAW MATERIALS & BOUGHT OUT ITEMS													
	Glass Mat	Average GSM	-		Review	Lot	Vendor Test Certificate	ISO 3374 / EN 13473-1	Manufacturer Standard	✓	H	R	R	TC Review
	Polymer Resin	Type of Resin	-		Review	Lot	Vendor Test Certificate	IS 6746	Manufacturer Standard	✓	H	R	R	TC Review
	Stainless Steel	Grade of SS	-		Review	Lot	Vendor Test Certificate	AISI 304	Manufacturer Standard	✓	H	R	R	TC Review
2.0	FINAL INSPECTION & TESTING													
	Finished Product	Size, Marking, Surface Finish, Quantity as per P.O., Accessories check	-		Visual & Dimensional	Random	Approved Drawings / Approved VPDS	Approved drawings / As Per PO	Manufacturer Standard	✓	H	RW	W	3 samples of Each Type & Size per lot
		Load Test & Deflection Test	-		Measure	Random	NEMA FG1 1993 / Approved VPDS	Approved NEMA FG1 1993	Manufacturer Standard	✓	H	RW	W	3 samples of Each Type & Size of Tray
		Flame Retardancy Test	-		Witness	1 per Lot	ASTM D 635	Ref. Burning Rate of Acrylic	Manufacturer Standard	✓	H	RW	W	1 sample per lot
		Oxygen Index Test	-		Witness	1 per Lot	ASTM D 2863	More than 21 / Approved Data Sheet	Manufacturer Standard	✓	H	RW	W	1 sample per lot
		Glass Content Test (By Burning & Weighing residue)	-		Witness	1 per Lot	Manufacturer Standard Procedure	Min 55%	Manufacturer Standard	✓	H	RW	W	1 sample per lot

LEGEND: W: WITNESS, R: REVIEW, H: HOLD, PS : Approved Purchase Specifications. INDICATION: 1 – GENERAL COMPOSITES (P) LTD. 2 – TPI (Third Party Inspection). 3 – BHEL – PEM, NOIDA. / End User.		PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL SIGNATURE & STAMP	APPROVED BY TPI SIGNATURE & STAMP
* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', RELEVANT DOCUMENTS SHALL BE SUBMITTED TO CLIENT FOR RECORDS.				

MANUFACTURING QUALITY PLAN							QAP DOC. NO.:				
CUSTOMER: PRODUCT: FRP CABLE TRAYS & ACCS.							INSPECTION CATEGORY : BULK ITEMS				
REV NO:							DATE:				
PAGE 2 OF 2											
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPT- ANCE NORMS	FORMAT OF RECORD	*D	AGENCY	REMARKS
										1 2 3	

		BOQ of Coupler Plates & Fasteners	-	Visual, Dimensional & Quantitative	Random	Approved Datasheet & BOQ of Couplers	Approved Drawings / As per PO	Manufacturer Standard	✓	H	RW	W	10 samples per lot
3.0	PACKING												
	Packaging		-	Quantity 100%	100%	P.O. / Packing List	As Per Specification	Manufacturer Standard	✓	H	R	W	
4.0	DOCUMENTATION												
	Documentation & Issue of IRN	Compliance to specifications	-	Review	Lot	-	Internal Inspection Reports, Raw Material TC's, Review of Type Test Certificates for Mechanical & Electrical Properties of Pultruded Profiles, as per approved Data Sheet / BHEL Spec. No. PE-	Inspection Release Note	✓	H	H	R	

LEGEND: W; WITNESS, R: REVIEW, H: HOLD, PS : Approved Purchase Specifications.		APPROVED BY	
INDICATION: 1 – GENERAL COMPOSITES (P) LTD. 2 – TPI (Third Party Inspection). 3 – BHEL – PEM, NOIDA. / End User.		APPROVED BY	
* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', RELEVANT DOCUMENTS SHALL BE SUBMITTED TO CLIENT FOR RECORDS.		TPI SIGNATURE & STAMP	

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :				
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-507-E007, REV. 0		SPECIFICATION TITLE: TECHNICAL SPEC FOR CABLE TRAY SUPPORT SYSTEM (BOLTABLE)				
				SHEET 1 OF 2		SYSTEM CABLING		ITEM : CABLE TRAY SUPPORT MATERIAL & ACCESSORIES (BOLTABLE)		DOC. NO. :		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL											
1.1	ROLLED SHEET	1.CHEM.& PHY. PROPERTIES	MA	VERIFICATION OF TC'S	100%	IS1079 (for hot rolled) IS-513 (for cold rolled)	IS1079 (for hot rolled) IS-513 (for cold rolled)	MILL TC	3/2	-	1/2	Steel shall be procured from SAIL/TISCO/RINL/BHUSAN/JINDAL STEEL/JINDAL ISPAT/ESSAR/LLOYD/ IISCO/ authorised SAIL Re Rollers.
		2.DIMENSIONS	MA	MEASUREMENT	100%	IS-1730/ APP. DATA SHEET	IS-1730/ APP. DATA SHEET	QC RECORD	3/2	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	IS1079 (for hot rolled) IS-513 (for cold rolled)	IS1079 (for hot rolled) IS-513 (for cold rolled)	QC RECORD	3/2	-	-	
1.2	ZINC	CHEM.COMP.	MA	CHEM TEST	EACH HEAT	IS-209	IS-209	QC RECORD	3/2	-	1/2	
2.0	IN-PROCESS											
2.1	FABRICATION	1.DIMENSIONS	MA	MEASUREMENT	100%	APPD. DRGS.	APPD. DRGS.	QC RECORD	2	-	1	Welding is to be done by qualified welders in accordance with ASME SEC. IX article III. WPS , PQR & WPQ to be reviewed during inspection.
		2.WELDING QUALITY	MA	VISUAL	100%	GOOD WELDING PRACTICE	FREE FROM DEFECTS & SLAG	QC RECORD	2	-	1	
		3.SURFACE FINISH	MA	VISUAL	100%	FREE FROM DEFECTS & SLAG	FREE FROM DEFECTS & SLAG	QC RECORD	2	-	1	
2.2	SURFACE PREPARATION	1.CLEANING, PICKLING, RINSING & FLUXING	MA	VISUAL	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2	-	-	
		2. SURFACE QUALITY	MA	VISUAL	100%	IS:2629	IS:2629	QC RECORD	2	-	-	
2.3	GALVANISING	1.TEMPERATURE OF BATH	MA	TEMPERATURE INDICATOR	CONTINUOUS	IS-2629	IS-2629	QC RECORD	3/2	-	-	Applicability of galvanizing shall be as per Annexure-2 to quality plan.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :					
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-507-E007, REV. 0		SPECIFICATION TITLE: TECHNICAL SPEC FOR CABLE TRAY SUPPORT SYSTEM (BOLTABLE)					
		SHEET 2 OF 2		SYSTEM CABLING		ITEM : CABLE TRAY SUPPORT MATERIAL & ACCESSORIES (BOLTABLE)		DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
3.0	FINISHED ITEMS	2. DROSS	MA	VISUAL	PERIODIC	IS - 2629	IS - 2629	QC RECORD	3/2	-	-		
		3. RATE OF IMMERSION	MA	VISUAL / MEASUREMENT	100%	IS - 2629 / MFR'S PRACTICE	IS - 2629 / MFR'S PRACTICE	QC RECORD	3/2	-	2		
		4.SURFACE QUALITY	MA	VISUAL	100%	IS - 2629	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX. STAIN. ETC.	QC RECORD	3/2	-	-		
3.1	SINGLE / DOUBLE CHANNELS, CANTILEVER ARMS, CLAMPS	1.DIMENSIONS DISTORTION	MA	MEASUREMENT	IS-2500 (PART 1) LEVEL S-4	APPD. DRG	APPD. DRG	INSP. REPORT	2	1	-		FASTENERS SHALL BE OF REPUTED MAKE
		2.SURFACE FINISH	MA	VISUAL	IS-2500 (PART 1) LEVEL S-4	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX. STAIN. ETC.	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX. STAIN. ETC.	INSP. REPORT	2	1	-		
		3.MASS OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-6745 / APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	2	1	-		
		4.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-2633	IS-2633	INSP. REPORT	2	1	-		
		5.THICKNESS OF ZINC COATING	MA	ELCOMETER	IS-4759	APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	2	1	-		
		6.ADHESION	MA	MECH.TEST	IS-4759	IS-2629	IS-2629	INSP. REPORT	2	1	-		
3.1.1	TYPE TESTING		CR	TEST	1 SAMPLE	APPD. TYPE TEST PROCEDURE	APPD. TYPE TEST PROCEDURE	INSP. REPORT	2	1	-		
3.1.2	WELD INTEGRITY TEST	SOUNDNESS	CR	MAGNETIC PARTICLE INSPECTION (MPI) DIE-PENETRATION (DP)	SAMPLE TESTED DURING TYPE TESTING	APPD. TYPE TEST PROCEDURE	NO DEFECT	INSP. REPORT	2	1	-		AFTER CARRYING OUT TYPE TEST, WELD INTEGRITY TEST TO CHECK THE WELD SOUNDNESS/ ACCEPTANCE SHALL BE DONE BY MANUFACTURER
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT: TITLE			SPECIFICATION NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-001, R-04			SPECIFICATION : TITLE		
		SHEET 1 OF 5		SYSTEM			ITEM : XLPE Power Cables			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIALS											
1.1	XLPE Compound	1. Physical properties	MA	Physical Tests	Sample/ Lot	IS:7098 & Mfrs Std./ Appd Data Sheet	IS:7098 & Mfrs Std. Appd Data Sheet	Test Report Log Book	3/2	-	1,2	Raw material verification as per approved sub-vendor list
		2. Elec.Properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	1,2	
1.2	Semi Conducting Compound	1. Phy.and Elec. Properties	MA	Phy.and Elec. Tests	-do-	Manufacturer's standard	Manufacturer's standard	-do-	3/2	-	1,2	
1.3	Copper Foil	1. Dimensions	MA	Measurement	-do-	Manufacturer's std./ Appd. Data sheet	Manufacturer's std./ Appd. Data sheet	Log Book	2	-	2	
		2. Physical, Chemical & Elect. Properties	MA	Phy., Chem. & Elect. Tests	-do-	IS:1897	IS:1897	Supplier's test report & log book	3/2	-	2	
1.4	PVC Compound (for sheath)	1. Physical properties	MA	Physical Tests	Sample/ lot	IS:5831/BHEL Specification	IS:5831/BHEL Specification	Log Book/ Test Report	3/2	-	2	
		2. FRLS Properties	MA	Envir/ Chemical	Sample/ lot	ASTMD-2863, ASTMD-2843, IEC-754-1	Appd. Data sheet	Log Book/ Test Report	3/2	-	2	
1.5	Galvanised steel wire/strip	1. Phy. and Elec. Properties	MA	Physical & Electrical Tests	Sample from each batch/ lot	IS:3975/ BHEL Specification/ Appd Data Sheet	IS:3975/ BHEL Specification/ Appd Data Sheet	Log Book/ Test Cert.	3/2	-	2	
		2. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2	
		3. Galvanization	MA	Galv. requirement	-do-	-do-	-do-	-do-	3/2	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		STANDARD QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-001, R-04			SPECIFICATION : TITLE			
SHEET 2 OF 5		SYSTEM		ITEM XLPE Power Cables			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.6	Copper/Aluminium Rods/Wires	1. Physical Properties	MA	Physical Tests	-do-	IS:613, IS-5484, IS:8130 & BHEL Specification	IS:613, IS-5484, IS:8130 & BHEL Specification	-do-	3/2	-	2	
		2. Chemical Composition & purity	MA	Chemical analysis	-do-	-do-	-do-	-do-	3/2	-	2	
		3. Electrical properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	2	
		4. Dimensions	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2	
2.0	IN PROCESS											
2.1	Wire Drawing	1. Physical, Electrical, Finish & dimension	CR	Phy. & Elect. Tests Visual / Meas.	Sample	IS:8130 & BHEL Specn.	IS:8130 & BHEL Specn.	Log Book	2	-	1	
2.2	Stranding of wires	1. No. of wires	MA	Counting	-do-	BHEL Specn, Apprd. Data Sheet & Relevant IS	BHEL Specn, Apprd. Data Sheet & Relevant IS	-do-	2	-	-	
		2. Sequence, lay length & Direction	MA	Visual, Meas.	-do-	-do-	-do-	-do-	2	-	-	
		3 Surface Finish	MA	Visual	-do-	-do-	-do-	-do-	2	-	-	
		4. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.3	Conductor Screening	1. Radial thickness	MA	-do-	Sample	BHEL Specn & Apprd. Data Sheet	BHEL Specn & Apprd. Data Sheet	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-507-00-Q-001, R-04			SPECIFICATION : TITLE			
		SHEET 3 OF 5		SYSTEM			ITEM XLPE Power Cables			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	Core Insulation (XLPE) (No repair permitted)	1. Surface finish 2. Concentricity # 3. Thickness of Insulation 4 Dia over insulation 5. Test on XLPE (Tensile & Elongation, Hot Set & Ageing Test) 6. Spark test or water immersion test (applicable for LT XLPE cables only)	MA CR CR MA MA CR	Visual Measurement Measurement Measurement Tests Electrical	100% Sample -do- -do- -do- 100%	- Mfr's Std./Appd. data sheet BHEL specn./Apprd. Data Sheet/ IS:7098 -do- -do- Mnfr's Std	-do- Mfr's Std./Appd. data sheet BHEL specn./Apprd. Data Sheet/ IS:7098 -do- -do- Mnfr's Std	Log Book Log Book Inspection Report -do- -do- Log Book	2 2 2 2 2 2	- - - - - -	1 1 - - 1 1	# To be checked at starting & finish end of Extruded Length	
2.5	Insulation Screening, (Non Metallic & Metallic)	1. Surface finish 2. Thickness 3 Overlap of Tape Band 4 Tightness of Tape Band	MA MA MA MA	Visual -do- Measurement Visual	Sample -do- -do- -do-	- BHEL Spec./ data sheet BHEL Spec./ data sheet Plant Std.	Free from bulging burnt particles lumps, cuts & Scratches. BHEL Spec./ data sheet BHEL Spec./ data sheet Plant Std.	Log Book -do- -do- -do-	2 2 2 2	- - - -	- - - -		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		STANDARD QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-507-00-Q-001, R-04			SPECIFICATION : TITLE		
		SHEET 4 OF 5		SYSTEM			ITEM XLPE Power Cables			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.6	Core Laying	1. Dia over laid up core	MA	Measurement	Sample	Apprd. Data Sheet	Apprd. Data Sheet	Log Book	2	-	-	
		2. Sequence of lay, & direction	MA	Visual & Meas.	Sample	IS 7098/ Mfrs.Std.	IS 7098/ Mfrs.Std.	-do-	2	-	-	
		3. Lay Length	MA	Meas.	-do-	Mnfrs. Std.	Mnfrs. Std.	-do-	2	-	-	
2.7	InnerSheath Extrusion	1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles, lumps cuts & scratches.	-do-	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	Appd. Data Sheet, IS:7098	Appd. Data Sheet, IS:7098	-do-	2	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
2.8	Armour	1. No.of wires/Strips	MA	Counting	At the start of the process	BHEL Specn./ Apprd.Data sheet	BHEL Specn./ Apprd.Data sheet	-do-	2	-	-	
		2. Lay Direction	MA	Visual	-do-	IS:7098	IS:7098	-do-	2	-	-	
		3. Lay Length	MA	Meas.	-do-	Plant Standard	Plant Standard	Log Book	2	-	-	
		4. Coverage	MA	Measurement	-do-	BHEL Specn./ Appd. Data Sheet	BHEL Specn./ Appd. Data Sheet	-do-	2	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.9	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Free from Bulging, burnt particles, lumps, cuts & scratches	Log Book	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	Appd. Data Sheet	Appd. Data Sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
		4. Marking	MA	Visual	100%	IS:7098, BHEL Specn. & Appd. Data Sheet	IS:7098, BHEL Specn. & Appd. Data Sheet	Test Report	2	-	-	Sequential marking shall be done by printing
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		STANDARD QUALITY PLAN SHEET 5 OF 5		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ :			QUALITY PLAN			SPECIFICATION :			
				VENDOR			NUMBER PED-507-00-Q-001, R-04			TITLE			
		SYSTEM			ITEM XLPE Power Cables			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	P	W	V	11	
2.10	Finished Cable	1. Routine Test 2. Type Tests *	CR CR	Elec. & Meas. Physical & Electrical Tests	100% Sample *	IS:7098 & BHEL specn Approved Type & acceptance test schedule	IS:7098 & BHEL specn Approved Type & acceptance test schedule & approved Data Sheet	Test Report -do-	2 2	- 1	1	* FOR HT: Type tests to be conducted on one size of each voltage grade except FRLS/ Flammability tests & Electrical tests which shall be conducted on every size & voltage grade of cables. * FOR LT: Type tests to be conducted on one size.	
3.0	Final Inspection	1. Finish & Length 2. Dimension 3. Armouring - Coverage No.of Wires/Strips 4. Marking & Colour Coding 5. Acceptance Tests	MA MA MA MA CR	Visual, Measurement Measurement Visual & Meas. Visual Phy, Elect. Tests	(See remark) As per IS -do- -do- -do-	BHEL specn. & IS:7098 Appd.Data Sheet/ IS:7098, IS:10810 -do- -do- Appd Data Sheet/ IS: 7098	BHEL Specn./ Free from Bulging Burnt particles, lumps, cuts & scratches Specn./ Appd. Data Sheet/ IS:7098, IS:10810 -do- -do- Appd Data Sheet/ IS: 7098	-do- -do- -do- -do- -do-	2 2 2 2 2	1 1 1 1 1	- - - - -	One drum in each Lot	
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION, VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER IS/ BHEL SPECIFICATION (D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER SAMPLING PLAN AGREED BY PURCHASER. (G) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.													
LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE													
		BHEL				PARTICULARS	BIDDER/ VENDOR						
						NAME							
						SIGNATURE							
						DATE						BIDDER'S/VENDORS COMPANY SEAL	

		QUALITY PLAN SHEET 1 OF 5		CUSTOMER :		PROJECT			SPECIFICATION :				
				BIDDER/ :		TITLE			NUMBER :				
				VENDOR		QUALITY PLAN			SPECIFICATION : PE-SS-888-507-E003				
				SYSTEM		ITEM : PVC CONTROL CABLE			SECTION			VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
1.0	RAW MATERIAL												
1.1	PVC Compound(for insulation and sheath)	1. Physical properties	MA	Physical Tests	Sample	IS-5831/BHEL Specification	IS-5831/BHEL Specification	Log Book/ Test Cert.	3/2	-	2		
		2. Elec.Properties	MA	Electrical Tests	Sample	-do-	-do-	-do-	3/2	-	2		
		3. Make & Type	MA	Visual	100%	Plant Std.	Plant Std.	-do-	2	-	-		
1.2	Galvanised steel wire/strip	1. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	IS-3975 BHEL Specification	IS-3975/BHEL Specification	-do-	3/2	-	2	* Sample from each Batch/Lot.	
		2. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2		
		3.Galvanization Quality	MA	Galv.Tests	-do-	-do-	-do-	-do-	3/2	-	2		
1.3	Copper/Aluminium Rods/ Wires	1. Physical Properties	MA	Physical Tests	-do-	IS-613 IS-5484 IS-8130 AND BHEL Specification	IS-613 IS-5484 IS-8130 AND BHEL Specification	-do-	3/2	-	2		
		2. Chemical Composition & purity	MA	Chemical analysis	-do-	-do-	-do-	-do-	3/2	-	2		
		3.Electrical properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	3/2	-	2		
		4.Dimension	MA	Measurement	-do-	-do-	-do-	-do-	3/2	-	2		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :PE-SS-888-507-E003			
SHEET 2 OF 5		SYSTEM		ITEM :PVC CONTROL CABLE			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	Wire Drawing , Tinning and Annealing	1. Physical, Electr. Finish & dimension	CR	Phy.&Elect. Tests Visual & Meas.	Sample	BHEL Specn. IS-8130	BHEL Specn. IS-8130	Log Book	2	-	1	
		2. Chemical test for Tinning	CR	Chemical Test	Sample	-do-	-do-	-do-	2	-	-	
2.2	Stranding of wires	1. No.of wires	MA	Counting	Sample	Vendors/BHEL Specn. & Apprd. Data Sheet & Relevant IS	Vendors/BHEL Specn. & Apprd. Data Sheet & Relevant IS	-do-	2	-	-	
		2. Sequence, lay length & Direction	MA	Visual, Meas	Sample	-do-	-do-	-do-	2	-	-	
		3 Surface Finish	MA	Visual	Sample	-do-	-do-	-do-	2	-	-	
		4.Dimension	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
2.3	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	-	Free from bulging burnt particles lumps, cuts & Scratches.	-do-	2	-	1	
		2 Insulation thickness	CR	Measurement	Sample	Appd.data sheet IS-1554	Appd.data sheet IS-1554	-do-	2	-	-	
			PARTICULARS		BIDDER/VENDOR							
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :PE-SS-888-507-E003			
SHEET 3 OF 5		SYSTEM		ITEM :PVC CONTROL CABLE			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	Core Laying	3. Concentricity #	CR	Measurement	Sample	Mfr's Std./Appd. data sheet	Mfr's Std./Appd. data sheet	Log Book	2	-	1	# To be checked at starting & finish end of Extruded Length
		4 Dia over insulation	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
		5. Spark Test or Water Immersion test	CR	Electrical	100%	Mfr's Std.	Mfr's Std.	-do-	2	-	1	
		6. Core identification	MA	Visual	100%	IS-1554	IS-1554	-do-	2	-	-	
		1. Dia over laidup core	MA	Measurement	Sample	-do-	-do-	Log Book	2	-	-	
		2.Sequence of lay, Lay length & direction up core	MA	Visual & Meas.	Sample	Mfrs.Std./relevant IS	Mfrs.Std./relevant IS	-do-	2	-	-	
2.5	InnerSheath Extrusion	1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles, lumps cuts & scratches.	-do-	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	IS-5831, IS-1554 data sheet	IS-5831, IS-1554 data sheet	-do-	2	-	-	
		3.Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
2.6	Armouring	1. No.of wires/Strips	MA	Counting	At the start of the process	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	-do-	2	-	-	
		2. Lay Direction	MA	Visual	-do-	-do-	-do-	-do-	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ :		QUALITY PLAN NUMBER PED-507-00-Q-002/02		SPECIFICATION :PE-SS-888-507-E003 TITLE: TECHNICAL SPECIFICATION FOR LT CONTROL CABLES				
				VENDOR		ITEM :PVC CONTROL CABLE		SECTION VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.7	Outer Sheath Extrusion	3. Lay Length	MA	Visual, Meas.	At the start of the process	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	BHEL Specn./ Appd. Data sheet IS-3975 & IS-1554	Log Book	2	-	-	Sequential marking shall be done by printing * One Drum/Size/Lot One drum each for Power & control cables in a Lot
		4. Coverage	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		1. Surface Finish	MA	Visual	100%	-	Free from Bulging Burnt particles, lumps, cuts & scratches	Log Book	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample	IS-5831 & IS-1554 Data Sheet	IS-5831 & IS-1554 Data Sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
		4. Marking	MA	Visual	100%	IS-1554 & BHEL Specn.	IS-1554 & BHEL Specn.	Test Report	2	-	-	
2.8	Finished Cable	1. Routine Test	CR	Elec. & Meas.	100%	IS-1554 & BHEL Specn	IS-1554 & BHEL Specn	Test Report	2	-	1	
		2. Type & FRLS Tests	CR	Elec., Phy & Meas.	Sample *	-do-/Apprd.data sheet	-do-/Apprd.data sheet	Test Report	2	-	1	
3.0	Final Inspection	1. Finish & Length	MA	Visual	(See remark)	BHEL specn. IS-1554	Free from Bulging Burnt particles, lumps, cuts & scratches	Test Report	2	1	-	
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN SHEET 5 OF 5	CUSTOMER :			PROJECT TITLE			SPECIFICATION :			
			BIDDER/ :			QUALITY PLAN			NUMBER :			
			VENDOR			NUMBER PED-507-00-Q-002/02			SPECIFICATION :PE-SS-888-507-E003 TITLE: TECHNICAL SPECIFICATION FOR LT CONTROL CABLES			
			SYSTEM			ITEM :PVC CONTROL CABLE			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		2. Dimension 3. Armouring - Coverage No.of Wires/Strips 4. Marking/Colour Coding 5. Acceptance Tests 6. Type & FRLS Tests	MA MA MA CR CR	Measurement Visual & Meas. Visual Phy & Elect. Tests Measurement	As per IS As per IS -do- -do- (SEE REMARK)	Appd.Data Sheet/ IS-1554 & IS-10810 -do- -do- -do- BHEL Specn. Apprd.Data Sheet	Appd.Data Sheet/ IS-1554 & IS-10810 -do- -do- -do- BHEL Specn. Apprd.Data Sheet	Test Report -do- -do- -do- -do-	2 2 2 2 2	1 1 1 1 1	- - - - -	Type Test shall be witnessed on one sample per type(conductor size) of every lot
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER BHEL SPECIFICATION (D) PURCHASER SHALL HAVE RIGHT TO WITNESS THE SPARK TEST AT CORE STAGE (E) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (F) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION (G) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN (H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION. LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER (1) BHEL/BHEL's CUSTOMER: 2-VENDOR : 3 SUB VENDOR												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 1 OF 2		VENDOR		QUALITY PLAN NUMBER PED-509-00-Q-001, REV-03			SPECIFICATION : TECHNICAL SPECIFICATION FOR ABOVE GROUND EARTHING & LIGHTNING PROTECTION MATERIALS			
		SYSTEM : GROUNDING		ITEM : EARTHING & LIGHTNING PROTECTION MATERIALS			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL											
1.1	MILD STEEL (FLATS & RODS) AS PER SPECIFICATION	1.CHEMICAL & PHYSICAL PROPERTIES	MA	VERIFICATION, OF TC'S	100%	IS:2062	IS:2062	MILL TC	3	-	2	REFER NOTE IN REMARK AT SL. NO.3
		2.DIMENSIONS	MA	MEASUREMENT	100%	IS - 1730	IS - 1730	QC RECORD	3/2	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	IS : 1079	IS : 1079	QC RECORD	3/2	-	-	
1.2	ZINC	1.CHEM.COMP.	MA	CHEM.TEST	SAMPLE	IS - 209	IS - 209	QC RECORD	3/2	-	1/2	
2.0	IN-PROCESS											
2.1	CUTTING, DRILLING	1.DIMENSIONS	MA	MEASUREMENT	100%	BHEL SPEC	BHEL SPEC	QC RECORD	2	-	1	
		2.SURFACE FINISH	MA	VISUAL	100%	BHEL SPEC	BHEL SPEC	QC RECORD	2	-	1	
2.2	SURFACE PREPARATION	1.CLEANING PICKLING, RINSING, & FLUXING	MA	MEASUREMENT	PERIODIC IN EACH SHIFT	IS:2629	IS:2629	QC RECORD	2	-	-	
		2.SURFACE QUALITY	MA	VISUAL	100%	IS:2629	IS:2629	QC RECORD	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				TITLE		NUMBER :						
		SHEET 2 OF 2		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-509-00-Q-001, REV-03			SPECIFICATION : TECHNICAL SPECIFICATION FOR ABOVE GROUND EARTHING & LIGHTNING			
		SYSTEM : GROUNDING		ITEM : EARTHING & LIGHTNING PROTECTION MATERIALS			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.3	GALVANISING	1.TEMPERATURE OF BATH	MA	TEMPERATURE INDICATOR	CONTINUOUS	IS - 2629	IS - 2629	QC RECORD	3/2	-	-	If vendor doesn't have his own galvanizing plant duly approved by BHEL PEM; then galvanizing shall be carried out at BHEL-PEM approved other galvanizing plants as per Annexure-2.
		2. DROSS	MA	VISUAL	PERIODIC	IS - 2629	IS - 2629	QC RECORD	3/2	-	-	
		3. RATE OF IMMERSION	MA	VISUAL/ MEASUREMENT	100%	IS - 2629/ MFRS PRACTICE	IS - 2629/ MFRS PRACTICE	QC RECORD	3/2	-	2	
		4.SURFACE QUALITY	MA	VISUAL	100%	IS - 2629	FREE FROM BURRS, ROUGHNESS, SLAG, FLUX, STAIN ETC.	QC RECORD	3/2	-	-	
3.0	FINISHED ITEMS	1. CHEMICAL	MA	CHEMICAL	1 No./LOT/SIZE	IS-2062	IS-2062	LAB TC	2	-	1	NOTE : SAMPLE SHALL BE SELECTED BY BHEL & TESTING SHALL BE DONE AT NABL/GOVT APPD LAB
		2.DIMENSIONS	MA	MEASUREMENT	IS 2500 (PART 1 LEVEL S-4	BHEL SPEC	BHEL SPEC	INSP. REPORT	2	1	-	
		3.SURFACE FINISH	MA	VISUAL	IS 2500 (PART 1 LEVEL S-4	BHEL SPEC	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN, ETC.	INSP. REPORT	2	1	-	
		4.MASS OF ZINC COATING	MA	CHEM. TEST	IS - 4759	IS-6745 / BHEL SPEC	BHEL SPEC	INSP. REPORT	2	1	-	
		5.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS - 4759	IS-2633	IS-2633	INSP. REPORT	2	1	-	
		6.THICKNESS OF ZINC COATING	MA	ELCOMETER	IS - 4759	BHEL SPEC	BHEL SPEC	INSP. REPORT	2	1	-	
		6.ADHESION	MA	MECH.TEST	IS-4759	IS-2629	IS-2629	INSP. REPORT	2	1	-	
NOTE: INSTRUCTIONS FOR QUALITY PLAN IS ATTACHED AS ANNEXURE-1.												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
								BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER		
				BIDDER/VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-005/01			SPECIFICATION TITLE		
		SHEET 1 OF 6		SYSTEM			ITEM :LCC'S / M. BOXES/ JN. BOXES			SECTION VOLUME III		
SL. NO.	NENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	GENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL/CHANNELS	1. DUCTILITY	CR	BEND TEST	SAMPLE	IS-1079/IS-513/IS-226	IS-1079/IS-513/IS-226	LOG BOOK	3/2	-	2	FOR SHEET STEEL
		2. SURFACE FINISH DEFECTS	MA	VISUAL	100%	FACTORY STD	NO RUSTING	-DO-	3/2	-	-	
		3. THICKNESS	MA	MEASUREMENT	100%	BHEL SPEC./IS-1730	BHEL SPEC./IS-1730	-DO-	3/2	-	2	
1.2	WIRES	1. SURFACE DEFECTS.	MA	VISUAL	100%	BHEL SPEC./IS-1554/IS-694/RELEVANT. IS	BHEL SPEC./IS-1554/IS-694/RELEVANT. IS	-DO-	3/2	-	-	ONLY APPROVED MAKES TO BE USED
		2. IR, HV, IR	MA	ELECTRICAL	SAMPLE	-DO-	-DO-	-DO-	3/2	-	-	
		3. TYPE / ROUTINE TESTS	MA	VERIFICATION OF TYPE / ROUTINE TEST CERTIFICATE	100%	-DO-	-DO-	MFR'S TEST CERT.	3	-	1,2	
1.3	ZINC INGOT FOR GALVANISING	CHEM. COMP.	MA	CHEM. TEST	EACH	IS-209	IS-209	TEST CERT	3/2	-	1,2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

		QUALITY PLAN		CUSTOMER			PROJECT		SPECIFICATION			
				BIDDER/ VENDOR			TITLE		NUMBER			
		SHEET 2 OF 6		SYSTEM			ITEM :LCC'S / M. BOXES/ JN. BOXES			SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.3	ELECTRICAL COMPONENTS LIKE FUSE, SWITCHES, INDICATING LAMPS, PUSH BUTTON, TERMINALS, GASKETS CABLE GLANDS AND LUGS	1. MAKE TYPE RATING 2. OPERATION/ FUNCTIONAL CHECK 3. IR, HV, IR	MA	VISUAL	SAMPLE	BHEL SPEC. & BOM	BHEL SPEC. & BOM	LOG BOOK	3/2	-	-	STANDARD CUT OUTS TO BE DONE WITH DIES & PUNCHES ONLY
2.0	IN-PROCESS CONTROL		CR	ELECTRICAL TEST	SAMPLE	RELEVANT IS AND CATALOGUE	RELEVANT IS AND CATALOGUE	-DO-	3/2	2,1	2	
2.1	NIBBLING/PUNCHING	1. CUTOUT SIZES	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	3/2	2,1	2	
2.2	PANEL FABRICATION	2. DEBURRING	MI	MEASUREMENT	100%	-DO-	-DO-	-DO-	3/2	-	-	
		1. DIMENSIONS	MA	MEASUREMENT	100%	APPR. DRGS	APPR. DRGS	LOG BOOK	3/2	2	-	
		2. ALIGNMENT	MA	MEASUREMENT	100%	MFR'S STD	MFR'S STD	LOG BOOK	3/2	2	-	
		3. WELDING QUALITY	MI	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2	-	
PARTICULARS			BIDDER/VENDOR									
BHEL			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDOR'S COMPANY SEAL												

		QUALITY PLAN		CUSTOMER			PROJECT			SPECIFICATION		
				BIDDER/ VENDOR			TITLE			NUMBER		
		SHEET 3 OF 6		SYSTEM			ITEM :LCC'S / M. BOXES/ JN. BOXES			SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.3	SURFACE PREPARATION AND PRE-TREATMENT (7 OR 8 TANK PROCESS)	1. PROCESS PARAMETERS LIKE BATH TEMP, CONCENTRATION, DIPPING/ REMOVAL TIME	MA	PROCESS CHECK	PERIODIC	BHEL SPEC., MFR. SPEC., IS-6005	BHEL SPEC., MFR. SPEC., IS-6005	LOG BOOK	3/2	-	-	IF SAND/SHOT BLASTING, ACID PICKLINGS IS NOT REQUIRED.
		2. SURFACE QUALITY AFTER EVERY DIP	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	-	
2.4	PRIMER APPLICATION & PAINTING	1. SURFACE FINISH & COVERAGE	MA	VISUAL	100%	MFR. SPEC., IS-6005	MFR. SPEC., IS-6005	LOG BOOK	3/2	-	-	
		2. FILM THICKNESS	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	3/2	-	2	
		3. SHADE	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	2	
		4. ADHESION	MA	SCRATCH TEST / CROSS OUT TAPE	TEMPLATE	-DO-	-DO-	-DO-	3/2	-	2	
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

		QUALITY PLAN SHEET 4 OF 6		CUSTOMER		PROJECT			SPECIFICATION			
				BIDDER/ VENDOR		TITLE			NUMBER			
				SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-005/01			SPECIFICATION : TITLE			
				ITEM :LCC'S / M. BOXES/ JN. BOXES					SECTION VOLUME III			
SL. NO.	NENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	GENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.5	WIRING, GASKET, NAME PLATE, COMPONENT MOUNTING ETC.	1. WIRING LAYOUT	MA	VISUAL	100%	APPD . DRGS & SPEC.	APPD . DRGS & SPEC.	LOG BOOK	3/2	-	-	PVC CHANNELS TO BE USED
		2. WORKMANSHIP AND FINISH CORRECTNESS COMPLETENESS	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	-	-	
2.6	GALVANISATION PROCESS	1. TEMP OF ZINC BATH	MA	TEMP. INDICATOR	CONTIN- UOUS	IS-2629	IS-2629	QC RECORD	2	-	-	
		2. DURATION OF DIP	MA	VISUAL	-DO-	MANUFACTURER PRACTICE.	MANUFACTURER PRACTICE.	-DO-	2	-	-	
		3. SURFACE QUALITY	MA	VISUAL	100%	-DO-	FREE FROM ROUGHNESS, FLUX, STAIN ETC.	-DO-	2	-	-	
		4. GROSS QUANTITY & AGITATION	MA	TESTS	PERIODIC	RELEVANT. IS	RELEVANT. IS	-DO-	2	-	-	
3	FINAL INSPECTION											
3.1	COMPLETE JUNCTION BOX/ LCC'S MARSHALLING BOXES	1. WORKMANSHIP & FINISH, PAINT SHADE/GALV. THICKNESS & ADHESION	MA	VISUAL	100%	BHEL SPEC. APPD. DRG RELEVANT. IS	BHEL SPEC. APPD. DRG RELEVANT. IS	INSPN REPORT	3/2	2.1	-	
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

		QUALITY PLAN		CUSTOMER			PROJECT		SPECIFICATION			
				BIDDER/ VENDOR			TITLE		NUMBER :			
		SHEET 5 OF 6		SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-005/01		SPECIFICATION TITLE			
					ITEM :LCC'S / M. BOXES/ JN. BOXES		SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		2. UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-5358	IS-2633	IS-2633	INSPN REPORT	2	1	-	
		3. THICKNESS OF ZINC COATING	MA	ELCOMETER	-DO-	BHEL SPEC.	BHEL SPEC.	-DO-	2	1	-	
		4. WIRING LAYOUT	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2,1	-	
		5. COMPONENT LAYOUT & FIXING, ACCESSI- BILITY AND SAFETY	MA	VISUAL	100%	-DO-	-DO-	-DO-	3/2	2,1	-	
		6. COMPONENT IDENTIFICATION (MARKING/ NAME PLATES)	MA	VISUAL	100%	APPD. DRG.	APPD. DRG.	-DO-	3/2	2,1	-	
		7. PROPER WIRE TERMINATION	MA	PULLING	SAMPLE	-DO-	NO LOOSE CONNECTIONS. ALL TERMINATION TO BE LUGGED	-DO-	3/2	2,1	-	
		8. DOOR LOCK FUNCTIONING	MA	OPERATON	100%	APPD. DRG	NO MISMATCH	-DO-	3/2	2,1	-	
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

		QUALITY PLAN		CUSTOMER			PROJECT		SPECIFICATION			
				BIDDER/ VENDOR			TITLE		NUMBER			
		SHEET 6 OF 6		SYSTEM			ITEM :LCC'S / M. BOXES/ JN. BOXES		SPECIFICATION TITLE			
SL. NO	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		9.OVERALL DIMENSIONS 10. CONTINUITY 11. IR-HV-IR 12.OPERATION INTERLOCKS ETC 13. TEMP RISE (IF APPLICABLE) 14. DEGREE OF PROTECTION & FLAME/ EXPLOSION PROOF NOTE: IF TC'S FOR DEGREE OF PROTECTION/EXPLOSION PROOFNESS IS AVAILABLE FROM AN INDEPENDENT LABORATORY FOR IDENTICAL DESIGN (SIZE SHALL BE SMALLER THAN THAT INDICATED IN THE TC) THESE TESTS NEED NOT BE REPEATED.	MA CR CR CR CR CR	MEASUREMENT ELECTRICAL ELECTRICAL ELECTRICAL OPERATION AND FUNCTION IN ENERGISED CONDITION ELECTRICAL WATER AND DUST TESTS, FLAME/ EXPLOSION TESTS	100% 100% 100% 100% ONE/ TYPE/ SIZE ONE/ TYPE	APPD. DRG. APPD. DRG., BHEL SPEC., & RELEVANT IS -DO- -DO- BHEL SPEC. RELEVANT IS -DO-	APPD. DRG. APPD. DRG., BHEL SPEC., & RELEVANT IS -DO- -DO- BHEL SPEC. RELEVANT IS -DO-	INSPN. REPORT -DO- -DO- -DO- -DO-	3/2 3/2 3/2 3/2 3/2 3/2	2,1 2,1 2,1 2,1 2,1 2	- - - - - -	IR-HV-IR TEST TO BE DONE BEFORE OPERATIONAL TESTS FLAME/EXPLOSION PROOF TEST, IF SPECIFIED IN BHEL SPEC.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDOR'S COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : TITLE			SPECIFICATION : NUMBER			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-558-00-Q-001/02			SPECIFICATION : STATION LIGHTING SYSTEM TITLE			
				SHEET 1 OF 4			SYSTEM			ITEM : ILLUMINATION			SECTION VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOC. [Vendor DS / Drg. / Spec.to be duly apprvd. by BHEL (& Cust. If required) ; otherwise BHEL-spec. / Drg. prevails.]	ACCEPT. NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	P	W	V	11	
1.0	LUMINAIRES & LAMPS	1. ACCEPTANCE TEST											
		a) VISUAL	MA	VISUAL	IS 10322 (PART5 SEC1)	IS 10322 / DS	IS 10322 / DS	INSP. REPORT	3/2	(2),1	-		
		b) IR (Dry)	CR	ELECTRICAL	IS 10322	-DO-	-DO-	-DO-	INSP./T. REPORT	3/2	(2),1	-	
		c) HIGH VOLTAGE	CR	ELECTRICAL	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-		
		d) DUST PROOF	CR	ELECTRICAL	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-	TYPE TEST Cert. BY MFR.	
		e) PHOTOMETRIC	CR	ELECTRICAL	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-		
		2. ROUTINE TEST											
		a) VISUAL	MA	VISUAL	100%	-DO-	-DO-	INSP. REPORT	3/2	(2),1	-	TYPE TESTS CLEARANCE FROM BHEL/CUSTOMER	
		b) IR (Dry)	CR	ELECTRICAL	-DO-	-DO-	-DO-	INSP./T. REPORT	3/2	(2),1	-		
		c) HIGH VOLTAGE	CR	ELECTRICAL	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-		
2.0	LIGHTING PANELS AND LIGHTING DISTRIBUTION BOARDS	1.DIMENSIONS	MA	MEASUREMENT	SAMPLE	DRG.	DRG.	INSP. REPORT	3	2,1	-	COMPONENTS TO BE OF APPROVED MAKE	
		2.PAINT SHADE/ THICKNESS	MA	VISUAL/ MEASUREMENT	-DO-	SPEC/DRG	SPEC/DRG	-DO-	3	2,1	-		
		3.DEGREE OF PROTECTION (INCLUDING EXPLOSION PROOF IF ANY)	MA	TESTS	1/SIZE	SPEC / RELEVANT STD.	SPEC / RELEVANT STD.	TEST CERT	3	-	2,1	TYPE TEST Cert. BY MFR.	
		4.PERFORMANCE TESTS	MA	ELECT.	100%	SPEC	SPEC	INSP./T. REPORT	3/2	(2),1	-	BHEL SHALL WITNESS ON RANDOM ONE SAMPLE, THOUGH EACH ITEM SHALL BE CHECKED BY THE MANUFACTURER	
		5.HV/IR/HV	MA	ELECT	100%	2.5KV AC FOR 1 MINUTE	2.5KV AC FOR 1 MINUTE	-DO-	3/2	(2),1	-	-DO-	
BHEL		LEGEND	LEGEND :	PARTICULARS		BIDDER/VENDOR							
		P-perform	1 - BHEL	NAME									
		W-witness	2 - BHEL's Vendor	SIGNATURE									
		V-verify	3 - Manufacturer	DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : 2X660 MW ENNORE SEZ			SPECIFICATION : PE-TS-412-558-E001 R1			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-558-00-Q-001/02			SPECIFICATION : STATION LIGHTING SYSTEM			
				SHEET 2 OF 4			SYSTEM			ITEM :ILLUMINATION			SECTION VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOC.	ACCEPT. NORM [Vendor DS / Drg. / Spec.to be duly apprvd. by BHEL (& Cust. If required) ; otherwise BHEL-spec. / Drg. prevails.]	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
3.0	LIGHTING TRANSFORMER	1. ROUTINE TEST											
		a) TYPE / RATING	CR	VISUAL	100%	IS 11171 / DS / Spec.	IS 11171 / DS / Spec.	INSP./T. REPORT	3/2		(2),1		
		b) WIND. RESISTANC	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		c) V. RATIO /VECTOR	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		d) Z VOLT/ Z SCKT	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		e) LOAD LOSS/ CURREN	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		f) NO LOAD LOSS	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		g) SOURCE WITHSTAND	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
		h) INDUCED O/V	CR	TEST	100%	-DO-	-DO-	-DO-	3/2		(2),1		
				2. TEMP.RISE TEST (FOR COMPLETE ASSEMBLED LDB)	MA	ELECT	1/RATING	SPEC / RELEVANT STD.	SPEC / RELEVANT STD.	INSP./T. REPORT	3/2	(2),1	-
4.0	CONDUITS <u>Conduit Type & relevant IS No. :</u> RIGID (Metallic or Nonmetllic) IS 9537 Flexible-Metallic IS 3480 Flexible-Non-metallic IS 6946	3. TYPE TEST	MA	TEST	1/RATING	-DO-	IS 11171 / BHEL SPEC.	TEST REPORT	3/2		(2),1	TYPE TESTS CLEARANCE FROM BHEL/CUSTOMER	
		1.MATERIAL	MA	VISUAL, MECH, & CHEMICAL	relevant IS	relevant IS	relevant IS	INSP./T. REPORT	3/2		(2),1		
		2.DIMENSIONS	MA	MEASUREMENT	relevant IS	relevant IS	relevant IS	INSP. REPORT	3/2		(2),1		
		3. GALVANISATION TEST											
		a) ZINC COATING	CR	INSP. / TEST	relevant IS	relevant IS	relevant IS	INSP./T. REPORT	3/2		(2),1	Not appl. for Epxy-coatd mtllic or Non-mtllic type conduit	
		b) MASS OF ZINC COAT.	CR	TEST	IS:9537	IS-6745/4759/SPEC	IS-6745/4759/SPEC	INSP./T. REPORT	3/2		(2),1		
		c) COATING THICKNESS	CR	TEST	S:9537OR348	IS:9537 OR 3480	IS:9537 OR 3480	INSP./T. REPORT	3/2		(2),1	BY ELCOMETER	
		4. EPOXY THICKNESS	MA	VISUAL/PHYSICAL	IS:9537	50 MICRONS	50 MICRONS	INSP./T. REPORT	3/2		(2),1	For Rigid condit Epoxy coated and not galvanised	
		BHEL		LEGEND	LEGEND :	PARTICULARS	BIDDER/VENDOR						
				P-perform	1 - BHEL	NAME							
		W-witness	2 - BHEL's Vendor	SIGNATURE									
		V-verify	3 - Manufacturer	DATE				BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : 2X660 MW ENNORE SEZ			SPECIFICATION : PE-TS-412-558-E001 R1		
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-558-00-Q-001/02			SPECIFICATION : STATION LIGHTING SYSTEM		
				SHEET 3 OF 4			SYSTEM			ITEM : ILLUMINATION		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOC. [Vendor DS / Drg. / Spec.to be duly apprvd. by BHEL (& Cust. If required) ; otherwise BHEL-spec. / Drg. prevails.]	ACCEPT. NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
5.0	ELECTRIC POLES MATERIAL	1.CHEMICAL COMP.	MA	CHEM. ANALYSIS	SAMPLE	IS-2713	IS-2713	TEST REPORT	3/2		(2),1	FOR DEFLECTION & DROP TEST, TC VERIFICATION BY BHEL
5.1		2.PHYSICAL PROP.	MA	PHY.TESTS	-DO-	-DO-	-DO-	-DO-	3/2		(2),1	
5.2	FINAL INSPECTION	1.WORKMANSHIP AND FINISH	MA	VISUAL & MEAS	SAMPLES	DRG./ IS:2713	DRG./ IS:2713	INSP. REPORT	3/2	(2),1	-	
		2.DIMENSIONS	MA	-DO-	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-	
		3.WEIGHT	MA	-DO-	-DO-	-DO-	-DO-	-DO-	3/2	(2),1	-	
		4.TESTS AS PER IS-2713	MA	-DO-	-DO-	IS-2713	IS-2713	INSP./T. REPORT	3/2	(2),1	-	
6.0	JUNCTION BOXES & RECEPTACLES	1.DIMENSIONS	MA	MEASUREMENT	100%	DRG./	DRG./	INSP. REPORT	3/2	-	[2]	COMPONENTS TO BE OF APPROVED MAKE If galvanised apply tests as per checks 3 a) & b) for conduits.
		2.PAINT SHADE/ THICKNESS	MA	VISUAL/MEAS.	SAMPLE	SPEC/DRG	SPEC/DRG	-DO-	3/2	-	[2]	
		3.HV/IR/HV	MA	ELECT.TESTS	100%	2KV AC FOR 1 MINUTE	2KV AC FOR 1 MINUTE	TEST REPORT	3/2	-	[2]	
		4.DEGREE OF PROTECTION	MA	TEST	1/SIZE	IS:2147	IS:2147	TEST CERT.	3/2		(2),1	
		5.SPECIAL TESTS IF ANY,EXPLOSION PROOF ETC.	MA	TEST	1/SIZE	IS:2148	IS:2148	TEST CERT.	3/2		(2),1	
		7.0	PVC WIRES	1.SURFACE DEFECTS	MA	VISUAL	SAMPLE	IS:694 / IS:1554	IS:694 / IS:1554	INSP. REPORT	3/2	
NOTE : TO BE PROCURED FROM APPROVED SOURCE ONLY.	2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-DO-	-DO-	-DO-	3/2		(2),1		
	3.TYPE TESTS	CR	ELEC.TESTS	ONE/TYPE & SIZE SAMPLING	BHEL SPEC. IS:694 / IS:1554	BHEL SPEC. IS:694 / IS:1554	TEST CERT.	3/2		(2),1		
	4.ACCEPTANCE TESTS	MA	-DO-		-DO-	-DO-	-DO-	3/2	(2),1	-		
BHEL		LEGEND	LEGEND :		PARTICULARS		BIDDER/VENDOR					
		P-perform	1 - BHEL		NAME							
		W-witness	2 - BHEL's Vendor		SIGNATURE							
		V-verify	3 - Manufacturer		DATE				BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : 2X660 MW ENNORE SEZ			SPECIFICATION : PE-TS-412-558-E001 R1		
				BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-558-00-Q-001/02			SPECIFICATION : STATION LIGHTING SYSTEM		
		SHEET 4 OF 4		SYSTEM			ITEM :ILLUMINATION			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOC.	ACCEPT. NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
8.0 9.0 10.0 11.0 12.0 13.0	CIRCUIT BREAKERS. Indicating Instrmts. / Meters Visual Indicating lamps Contactors Relays Timers	5.ROUTINE TESTS	MA	-DO-	100%	IS:694 / IS:1554	IS:694 / IS:1554	TEST CERT.	3/2		(2),1	
		6.FRLS PROPS.	CR	FRLS TESTS	SAMPLES	BHEL SPEC	BHEL SPEC	-DO-	3/2	(2),1	-	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
									3/2		(2),1	
NOTES: 1. Agency code indication as "3/2" under activity code col. "P" means , it is performed by either agency "3" or agency "2" ; Agency code shown in parantheses as (2), under activity code col. "W" or "V", is applicable if agecy "2" was not involved in activity "p". 2. IN CASE TYPE TEST CERTIFICATE FOR DEGREE OF PROTECTION/EXPLOSION PROOFNESS FROM INDEPENDENT LAB. IS NOT AVAILABLE, THE ITEM SHALL BE TESTED AT AN INDEPENDENT LAB. 3. ITEMS LIKE CEILING FANS, EMERGENCY LIGHTING UNIT, CABLE GLANDS / LUGS, EARTHING WIRE & FLATS, 24V SUPPLY SYSTEM LADDERS, HUME PIPE, SWITCHBOXES, STRUCTURAL STEEL ETC. WILL BE CLEARED BASED ON TEST CERIFICATE VERIFICATION BY BHEL.												
BHEL		LEGEND	LEGEND :	PARTICULARS	BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL				
		P-perform	1 - BHEL	NAME								
		W-witness	2 - BHEL's Vendor	SIGNATURE								
		V-verify	3 - Manufacturer	DATE								

ANNEXURE-1

INSTRUCTIONS FOR QUALITY PLAN

The Quality Plan shall include all the Quality Control Measures and Checks adopted by the Vendor to ensure that the material/component/assembly/services supplied by him meet/will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, processes, manufacture, assembly, packing and despatch. The following guide lines may be noted:

- Column 1- Serial Number
- Column 2- Component/Operation- The component and/or operation being checked shall be given here.
- Column 3- Characteristics check- The characteristics being checked shall be given here, e.g., chemical composition, mechanical properties, leak tightness, surface defects etc..
- Column 4- Category -'CR' stands for critical characteristic - affecting safety of equipment and personnel
'MA' stands for major Characteristic - affecting safety of equipment and personnel
'MI' stands for minor characteristic - affecting appearance etc.
- Column 5- Type/Method of check e.g. chemical analysis tensile testing, hydraulic test, visual examination radiography etc.
- Column 6- Extent of check, such as, 100, 10, 1 percent etc.
- Column 7- Reference Documents - Documents, such as technical specification, drawings, standard specifications (IS, BS ETC.) procedure, etc. according to which check is done.
- Column 8- Acceptance Norms - Standards etc. according to which acceptability or otherwise of the characteristics being checked is decided.
- Column 9- Format of Record - Formats, log sheets, reports, etc. in which the observations are recorded. Standard log sheets, reports, formats etc. of the Vendors shall be numbered and such reference numbers shall be included here.
- Column 10- Agency - The agency which performs the test/instruction shall be written in sub-column 'W'
The agency which verifies test certificates/inspection records and carries out audit check of the components/operation shall be written in sub-column 'V'
- The agencies are codified as 1,2 & 3
- '1' stands for (BHEL)
- '1' * means the operation shall be cleared by BHEL before the start of the next operation.
- '2' Stands for Vendor
- '3' stands for sub-Vendor of the Vendor and so on.
- Example :
- Entry '3' in column 'P' means test/inspection to be performed by sub-Vendor's QC
- Entry '2' in column 'W' means test/inspection to be witnessed by Vendor's QC
- Entry '1' in column 'V' means verification shall be done by BHEL and next stage to be started only after the hold point is cleared by BHEL
- Column 11- Remarks - Any special remarks shall be given here.

NOTES :

1. In absence of correlation with the test certificate(s) (e.g. material identification) samples shall be drawn by BHEL and all tests as per relevant specifications shall be carried out in their presence or in recognized Government Laboratory.
2. When materials and components are initially identified and stamped by BHEL QS engineer, the identification marks shall be preserved till despatch. Wherever this is not possible, the identification mark shall be transferred to the components in the presence of BHEL QS Engineer unless otherwise agreed.
3. For castings and forgings integral test specimens shall be provided, When this is not possible for casting, they shall be poured in the presence of BHEL QS Engineer unless otherwise, if witnessing of test by BHEL is called for.
4. When welders qualified by reputed inspection agencies or statutory bodies are not available, qualification tests shall be conducted in the presence of BHEL QS Engineer.
5. This Quality Plan is liable to be modified as per the requirements of approved drawings and changes in technical specifications/drawings. If there are contradictions in respect of column 7 & 8 between this Quality Plan and the approved drawings specifications, the latter shall prevail.
6. Wherever inspection by BHELs Purchaser/Third Party/Statutory authorities are mandatory, this shall be complied with.
7. Inspection reports, log sheets, test reports/certificate. etc. shall be furnished to BHEL at the appropriate stages or at the time of final inspection, as required.
8. This Quality Plan is also applicable to spares, if any, under scope of supply of Vendor.
9. The quality plan shall be submitted in minimum 4 copies with a soft copy of the same or in line with contract requirements.